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SOME REMARKS ON THE TRAINING AND ACTIVITIES OF THE ORTHOPAEDIC SURGEON*

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Mr. President and Gentlemen:

My first duty and pleasure is to thank you for the lasting honor you have conferred upon me by having allowed me to preside over you for the last six years. My gratitude is very deep, and far beyond my power to express. To the Council I tender my warm appreciation of their kind and thoughtful help. I hope that my distinguished successor, whom I congratulate, may experience in equal measure the joy and dignity of office.

The branch of surgery which we practise has made very encouraging progress during the years that have followed the war. This is due largely to our loyalty toward one another and the fraternal interest we all take in each other's work, but more especially, I venture to think, to the amicable relationship and understanding engendered between ourselves and our colleagues in all other departments of surgical activity. It is now generally recognized that no single brain is sufficiently capacious to deal safely with every department of general surgery, and that in future surgeons will divide into groups, each endeavoring to advance and perfect the section to which he is attracted. It is only in this way that satisfactory progress can be achieved, for our energies will then be concentrated upon problems within our compass. Speaking in general terms, we devote our energies as a body to the surgery of the spine and extremities and also to certain paralyses affecting the arms and limbs. This, of necessity, comprises a very large section of general surgery, and if our work is to be pro-

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gressive it demands that we should undergo a thorough training in the other branches of general surgery. If we look back thirty or forty years or more we will note that the orthopaedic surgeon was chiefly a mechanician. Tenotomies were his main, if not his whole operative attack. He was not trained in operative methods. All honor to those early pioneers. They taught us the possibilities of conservative methods by laborious and painstaking attention to detail. Their efforts proved the essential groundwork upon which their modern successors have advanced. Had we been content with this narrow outlook we would deservedly have remained a comparatively unimportant sub-section with very limited activities, quite insufficient to advance our art. In recent years, however, we have infused into our work a true surgical spirit, and from a closer association with the so-called general surgeon we have imbibed a wider outlook. I feel confident that our future lies in a still closer affiliation with all branches of medicine and surgery, and that we should work together shoulder to shoulder rather than from separate angles. We should be known not by the label which is attached to us—which in many ways is unfortunate—but by the excellence of our work. The Great War did signal service to us in that it brought into close contact surgeons whose activities lay in different directions. The groups of cases which were included in the war-time definition of orthopaedic surgery called for the highest surgical skill, and partially trained men were not in demand. Indeed, the problems we met with could be solved only by those whose training embraced a sound knowledge of the fundamental principles of general surgery. Orthopaedic surgery of the future will demand a no less efficient standard, and for this reason attention should be directed to the adequate training and equipment of our successors. The surgery of bones and joints covers so large an area, and is so fascinating a branch of surgery, that it cannot fail to attract the highest type of student, and for the same reason it will continue to offer less inducements to men of inferior training and capacity.

I have from time to time received many inquiries from medical friends as to the type of training which they should give their sons in order to equip them for orthopaedic work. This I can best do by striking a personal note, and under the circumstances perhaps you will forgive me.

When I look back upon my own life with its early struggles and disappointments I sometimes reflect what I should do if my surgical career were beginning afresh at this date. Of this I am quite sure, I would select the surgery of joints and bones as my future field of activities. However great the modern achievements in this fascinating field of surgery, I am

more than convinced that the vista is only just opening, and that the future will unveil numberless avènues of research and achievement which now remain hidden. I should, therefore, endeavor to make my education sufficiently comprehensive to enable me to appreciate the scientific basis of any new advance, and to maintain a technical facility to traverse any fresh operative avenue. I would pay a specialized attention to anatomy and physiology, not merely for examination purposes, but with the intention of retaining these sciences as close friends during the whole of my surgical career. With this end in view I would try to obtain a post in the anatomy rooms. Twelve months or two years spent in this way would prove an invaluable foundation for future training. The physiology, particularly of the nervous system and of muscle function, is becoming more and more essential. These sciences must be mastered in one's youth; they cannot be assimilated in later life, and it is *assimilation* that is needed. I should also make a point of striving for the highest surgical qualification. The Fellowship of the Royal College of Surgeons is a possession which becomes increasingly necessary to an ambitious surgeon, in spite of the fact that the examination could with great advantage be materially improved. In my early career I constantly regretted not having worked for it. To fail many times even is an education in itself, and I very much admire the men who obtain this elusive qualification after they have started practice, a difficult achievement, for the diploma is so much more easily taken direct from the schools. After filling the hospital house appointments I should continue to acquire a knowledge of general surgery in all its branches. It is at this early stage, in spite of all temptations, that I would refuse to be deflected to the practice of any special branch. If available I should take an assistant surgeonship. In my own case nothing has served me so well as my experience as a general surgeon. It broadens the outlook, and if it is determined later to give allegiance to the surgery of the extremities and spine an excellent opportunity presents itself to acquire a sound knowledge of surgical pathology, more especially of the bones and joints. While in the hospital, and certainly after leaving it, I should keep in close touch with the neurological department. A very close relationship exists between neurology and our own work, and I should strongly advise all young surgeons about to take up orthopaedic work to acquire familiar knowledge with the chief types of neurological disease. In my own work I call for assistance from the neurologists very often, and I find great advantage in an interchange of opinion. We can be of great help to the neurologist, and he can be of very great use to us.

My advice, therefore, is not to specialize too early, and, where it is possible, to do active surgical work as part of the training before limiting our sphere of work. Facility in operative technique is best attained in youth. There should not be an interregnum. Early middle age is a fatal period to start operating.

If a surgeon can obtain an orthopaedic post after a few years in general surgery he is fortunate. He can then devote his whole energies to his more specialized work. If there is no orthopaedic department he can become full surgeon and work chiefly on the spine and extremities. In either case he is in a sound position. I was full surgeon to a general hospital for over twenty years, and during the later stages confined my work to the surgery of the extremities and spine.

As soon as possible after qualification I should endeavor to travel, not necessarily abroad. I should carefully choose my clinics in the hope of adding to my information. I have little regard for the self-satisfied surgeon who has nothing to learn—he generally has nothing to impart. If he confers distinction upon a clinic by a visit it is generally in the spirit of a self-satisfied critic. A surgeon, whether young or old, who ceases to imbibe information should be put aside to rest. His activities will never be missed. If a man possesses the true spirit, like the bee he will gather honey all the day, nor will he bear an ill impression of the flower. When the time arrived to specialize I should endeavor to become attached to a country open-air hospital in a visiting capacity. This would enable me to become familiar with the more chronic types of disease and their efficient handling. To keep abreast of modern surgical literature should be almost an obsession. There are some surgeons who find difficulty in reading. They trust entirely to ocular demonstrations and they retain such lessons well, but if we are to *teach* effectively we must read. Our attitude of mind should, however, always remain critical. Even if we do not subscribe to new doctrines or methods, they are always stimulative to our faculties and very often lead to new lines of thought and investigation. If I had been well acquainted with the works of Hippocrates I should have known that his treatment of club foot differed very little from my own 2000 years later, and that open-air wards—very much on the lines of our Heswall Hospital—were attached to the Temple of Aesculapius. Such knowledge is a useful check to the arrogant spirit. If I started my career anew and had thrust upon me—in season and out of season—the edicts of the Liverpool or any other School I think I should like to make careful and critical inquiries before accepting them. The history of medicine would present an unusual phenomenon if in Liverpool, for

instance, all orthopaedic progress ended with the death of Thomas. He doubted most things he read, and were he alive today he would have subscribed to many doctrines unknown to him at the end of the nineteenth century. No! the critical spirit is the soul of progress. It should be encouraged and it should be allied to a spirit of introspection. It is not from a desire to "Ring out the old, ring in the new," but from a determination to become emancipated from a false doctrine, no matter how hallowed by tradition. As my years advanced I should welcome criticism from my younger colleagues, for to grow up in their friendship and trust would be the greatest joy of life and add brightness to one's declining years.

From the first I should endeavor to assist the State, local authorities, and the public to minimize the evils upon which as a department in surgery we thrive. The often sordid controversies of political life have little charm for most of us, but we should all feel intensely the privilege of putting forth our strength in helping to eradicate the origins of disease.

Another and perhaps even more important aspect than the equipment of the orthopaedic surgeon is the training of the student. It is pretty generally agreed that it has been less than satisfactory in the past, and I think now the time has come to offer suggestions as to the most effective methods of dealing with the problem. This is rendered much easier because during the last few years many of our medical schools have realized the need there is of giving more attention to this important field of surgery. A little while ago I dealt with the organization and teaching of fractures, a subject rendered urgent and imperative because of the increasing industrial demands. On that occasion I emphasized the point that the first essential was that the teacher, whether he be called a general or an orthopaedic surgeon, should be interested in his subject and competent to teach it, and that there should be adequate bed accommodation. This is equally true in regard to the surgery of the spine and extremities. Let us fully realize that orthopaedic surgery is a considerable branch of general surgery. It is as distinctive a branch as that of the abdomen. The abdominal surgeon, the neurologist, and the orthopaedic surgeon are all branches of the general surgical trunk. They all interest themselves in different anatomical areas. They require, nevertheless, to be trained in the fundamental principles which govern each of the three divisions. If, at a low estimate, the surgery of the spine and extremities occupies a third of the whole field of surgery, it follows there should be a proportionate bed accommodation for cases requiring ward treatment. Whether the cases or the surgeons are called orthopaedic or not

makes no difference. This important and extensive section of general surgery must have ample hospital accommodation under the control of a surgeon interested and trained for the work. The surgeon at the head of such a department of general surgery must obviously have adequate staff rank, and be allowed his share in the executive control of the student's time. I have discussed the teaching of the student with my friends, Bristow and Platt, who are in close touch with teaching centres, and we are all agreed upon certain basal principles. In the first place the orthopaedic surgeon should, where possible, branch off to his special work after obtaining a practical knowledge of general surgery by having practised it. This is best effected by first serving as an assistant surgeon, taking a special interest in the surgery of the spine and extremities. While in this position he might procure a post at a country hospital where the material would be complementary to that of the city hospital; he might also take part in a cripple scheme as visiting surgeon to after-care clinics. If the general hospital to which he is attached has already a recognized orthopaedic unit in charge of a full surgeon, the young surgeon should act as assistant surgeon both to the special unit and to a general surgical unit. This is the arrangement that obtains at King's College Hospital under the aegis of our President. The next period should be one of pure specialization, and the surgeon's activities should be devoted to orthopaedic surgery. This specialization might be determined by the appointment of the assistant surgeon to full charge of the orthopaedic unit on the retirement of the senior, or by the creation of a new orthopaedic surgical unit in a hospital where none existed previously. In this case the assistant surgeon would now take the title of orthopaedic surgeon to the hospital, and be awarded the status of a full general surgeon. This is what happened both at the Royal Southern and Northern Hospitals in Liverpool. In each instance the surgeon withdrew from the general field and devoted himself exclusively to orthopaedic surgery. In both hospitals the surgeons were given charge of a purely orthopaedic department. Once we have an established orthopaedic unit it must take its share in teaching. As representing a department of general surgery this unit must be responsible for teaching students the surgery of the spine and limbs. In this way orthopaedic surgery becomes an integral part of general surgery instead of a watertight department struggling for expansion. With full staff recognition and an adequate supply of beds the orthopaedic surgeon takes his position with the rest of his colleagues in the teaching of surgery. His lectures and demonstrations should not be looked upon as a special course any more than the lectures on the thorax, brain, or abdomen.

Both he and his colleagues in friendly combination cover the ground of what we call general surgery. In this way the teaching of surgery is undertaken by a team instead of by an individual, and each man who teaches is an expert in the field he covers. The less the subject is made a separate specialty from the student's point of view the better. He must be taught to regard it as "surgery." He should attend surgical out-patients and find that on one certain day the cases he sees and is taught about are what we call orthopaedic. He need not even know the name. He should come to know that on certain days in out-patients he is better and more clearly instructed on the prevention and cure of deformity. If the teaching is good it will become sought after.

In my first presidential address in 1920, and in my Cameron Lecture in 1921, I dealt with the question of post and under-graduate training so there is no need to pursue this subject now. There seems but little opportunity offered to the post-graduate who desires a course of systematic training, and yet what need there is for it! The Royal National Orthopaedic Hospital with its wealth of material and representative staff should be able to supply this need in London, and the Southern counties, Oxford, Shropshire, and Birmingham, should be available for other districts. If a really serious effort were made to cater for the post-graduate a pressing need would be supplied.

It is true that there are many of us who have been unable to avail ourselves of a training such as I have outlined. Surgeonships to hospitals are not always ready to hand, neither are they open to all. Immediately after the war I wrote, "It is now recognized that an essential preliminary to orthopaedic efficiency involves a thorough practical training in general surgery. With the expansion of its scope a high degree of skill is demanded by its votaries, and no one will now venture to practise with any false notion that the road is an easy one. In addition to operative skill it demands special qualities of mind; mechanical aptitude and untiring perseverance and patience are not the least important of these." We must remember with pride that many of the older orthopaedic men of today have made great reputations, and have done admirable pioneer work although they have never filled the post of general surgeon to a hospital. This success has involved a very uphill fight and is a remarkable achievement, but we must see that by a better organization of study and training the orthopaedic surgeons of the future will have their path made easier. Our progress during recent years is well illustrated both in the creation of new orthopaedic departments in many of our general hospitals and the opening of open-air hospitals or annexes in various parts of the country.

These are salutary signs, for the orthopaedic department is a recognition of the need that is being manifested of more attention to a section of surgery which has hitherto suffered from neglect. These departments connote a complete equipment which allows the surgeon to deal more effectively not only with the deformities of children, but also with the demands of industrial activity. Under the guidance of the surgeon, physiotherapy is placed in a proper perspective and is not allowed to run rampant along blind alleys. This means a great deal to those who require guidance in massage, electricity, and other forms of physiotherapy. Our masseurs and masseuses have shown extraordinary loyalty to our profession, often under trying circumstances. They are keen for instruction and explanation, and frequently get neither.

Our interest in the preventive side of the cripple problem has resulted in a strong public desire to help in a campaign which bids fair to become truly national. After-care centres and hospital schools are springing into being on every side. The State and local authorities give us not only their blessing, but their help. The time is not very far distant when every crippled child will have the advantage of education and skilled treatment in fresh air and sunlight. Here lies work which we all have at heart, requiring not only enthusiasm, but a spirit of understanding, in order to overcome difficulties and allay doubts.

In connection with this problem it is incumbent upon us to educate the public, and put pressure on the authorities to exercise all their powers in stamping out such diseases as tuberculosis and rickets. We can all of us take part in an agitation for a pure milk supply. Efforts which should be national and compulsory are now isolated and sporadic. What will the next generation say of a people, who, knowing the nature and danger of the tubercle bacillus, permitted infected milk to pour into their cities? For many years most of us have known of the close relationship between fresh air, sunshine, food, and rickets, but now, owing to the researches of Melanby, Chick, Leonard Hill, and others, we have this relationship explained and placed on a scientific basis. The State is supplied already with sufficient data to eradicate the disease, and we should take every opportunity of impressing upon local authorities their grave responsibilities, so that our out-patient departments are freed from rachitic deformities.

How delightful it is to see the efforts that are being made all over the country for the emancipation of the crippled child, but do not let us forget the pathetic plight of the *adult cripple*. Hardly a day passes without our being confronted with his problem. If a cripple has passed the

age of fourteen it is next to impossible to offer him adequate help. We have all the desire and the knowledge, but we lack the opportunity. It is true that certain hospitals, such as the National Orthopaedic, the Shropshire Orthopaedic, and the Wingfield Hospitals, undertake the treatment of the adult, but there are vast districts in the country which offer no facilities of any kind. These unfortunate victims of disease and deformity have passed from youth to adolescence in an atmosphere perhaps of pity, but outside the pale of surgical assistance. They deteriorate both mentally and physically, and rapidly become derelict, for their age prevents their admission into educational institutions to make them self-supporting. The adult cripple of today must seek admission in the wards of a general hospital, and we know that, without questioning the capacity of any surgical staff to handle far advanced orthopaedic cases, as in the case of a child, there is no accommodation there for patients requiring several weeks or months of continuous treatment—nor is there any provision for after-care. He is evacuated from hospital before he is cured in order to accommodate an urgent case, and apart from an occasional visit from the district nurse he is completely cut off from medical supervision. The adult cripple has a right to expect from the State equally considerate treatment as in the case of a child. Beds should be available for him in country orthopaedic hospitals, and if there be no recognized system of after-care in his own locality, facilities should be given him to remain within the after-care circuit of the orthopaedic hospital where he has received treatment. As an association of surgeons we should do our utmost to mitigate the tragedy of the adult cripple by securing for him adequate treatment, educative facilities, and help to employment. In the dismantling of Poor Law Infirmaries, which is under immediate contemplation, hope may be in sight. Many of these could be equipped to deal with this problem in proportion to its urgency and gravity. I would urge the Ministry of Health to give this suggestion their earnest consideration and help.

One great advantage of the campaign which is being waged on behalf of the cripple is the dissemination among the poor and partially educated of a knowledge of the laws of health. Ignorance of the laws of health, however, is surprisingly apparent among the rich and educated. This is evident in many directions, but I will refer only to their attitude in regard to some of our public and preparatory schools. We are all proud of our public schools. In many respects they are unequalled in any other country. They engender a fine and wholesome spirit of sacrifice and honor. They have consequently drawn upon the most distinguished and most cultured of our people, and yet in many ways they suffer from a worship

of the past. Whatever historic and psychologic value an ancient public school may possess in tradition—and they are many—there ought not to be a worship of antiquity of buildings, surroundings, and customs which were originally dictated by sheer practical necessity, but are now quite undesirable. In early days schools like castles were erected near water, often in damp, marshy places. They were confined in space, ill lighted, ill ventilated, with small unsanitary studies, low ceilings, and the inmates fed on rough, unvaried food. These were the practical relations of invention to necessity.

In a properly regulated routine, which aims at the correct relationship between mental and bodily health and the essentials of growth, the first consideration should be one of opposition to the mediaeval tradition. I have the sincerest admiration for our public school doctors and am constantly made witness to their care and skill. They should be given full opportunities to bring the schools under their control into line with the full requirements of modern hygiene. We want a Goldthwait in this country to bring home to our educational authorities the relationship of school hygiene to vigorous mental and physical manhood.

These are only a few of many kindred subjects which I hope will continue to engage the activities of the orthopaedic surgeon.

Let us realize our part in modern civilization and the future of our race. We are becoming more and more closely associated with all these public bodies, such as the Ministry of Health, the Board of Education, local authorities, and charitable societies, in the concerted endeavor to educate and guide public opinion in the essential laws of health. Recovery from disease has no longer become our sole ambition and object. That middle distance of our calling is receding on the horizon, and the prevention of grave disorders and impoverished vitality is the new and supreme ideal of natural happiness and well-being.

THE SO-CALLED INFRACTION OF THE SECOND METATARSAL BONE

BY ALBERT H. FREIBERG, M.D., CINCINNATI, O.

In December, 1913, I read a paper before the Southern Surgical and Gynecological Association describing a condition affecting the distal end of the second metatarsal bone, concerning which I had been unable to find any mention in literature. Six cases were reported, the first having been observed in 1903. The publication was made in August, 1914. (Surgery, Gynecology and Obstetrics.) It will be sufficient for the present purpose to say that I looked upon the condition as the result of trauma. Four of the six cases gave a traumatic history and the appearance in the roentgenograms was such that this origin seemed to me to be the most likely. I refer principally to the fact that the distal end of the bone was flattened and that in three of the six cases loose bodies were present. While four of the cases were in girls under eighteen years of age, only one was as young as fourteen. The first case was in a girl of sixteen, whose roentgenogram showed the epiphyses entirely united with the shafts of the metatarsals; another patient was twenty years old, and two were women over thirty. For these reasons the condition did not appeal to me as being related to adolescence.

Some time after my publication above referred to, there appeared a description of this same condition by Koehler, of Wiesbaden, in the first edition of his book (Grenzen des normalen u. Anfaenge des pathologischen im Roentgenbilde). In the American Journal of Orthopaedic Surgery, October, 1917, there appeared a report of four typical cases of this condition by W. C. Campbell. Since that time there have appeared numerous papers dealing with this subject and in some of these have been presented the results of microscopic studies on material removed by operation. Careful reading of the accounts of these studies will make it evident that they have brought about no unanimity of opinion regarding the etiology, or indeed, the essential nature of this condition. It is not even apparent that they have contributed greatly to our knowledge regarding it beyond that which we had already learned from clinical observation and roentgenologic studies. Since the publication of my paper in 1914 I have seen several additional cases of typical character. None of them has required

operation and they have yielded nothing in the way of new information other than the impression that in the younger patients the flattened end of the metatarsal gives an impression akin to that of sequestration, except for the absence of the zone of separation.

Koehler (Muench. med. Woch. 1924, Bd. 71) has called attention to the fact of the original report of this condition by me, but emphasizes the view that it constituted an incomplete, or even erroneous observation: this, in so far as there was lacking mention of the widening of the joint line, thickening of the shaft of the metatarsal, together with the obliteration of its neck. He considers it altogether unlikely that trauma plays the rôle of fundamental importance in the etiology (see also Koehler: Grenzen d. normalen, etc; 4th Ed. 1924, p. 77 and also p. 85).

The purpose of this communication is to make brief comment upon the above statements and to report a case which has a bearing of interest. The revision of the cases which have been reported, together with those which have been observed more recently, shows that the thickening of the metatarsal shaft is uniformly present and that it stands in no constant relationship to the amount of deformity of the end of the bone which has taken place. If this be true, the observation by Koehler constitutes an important element of this condition and one which I had failed to note. I consider it proper that this should be acknowledged. In addition, however, there is here offered the report of a case which seems to be in point.

The patient, a boy, thirteen years of age, was seen in February, 1925, because of a painful condition of the right foot. The duration was about nine months and he ascribed the condition to an injury sustained at play. The pain was located in the metatarso-phalangeal joint of the second toe. There was slight swelling on the dorsal surface of this joint, it was quite tender to pressure, and the finger detected considerable thickening. Crepitation on moving the joint could not be detected. The foot seemed normal in other respects. A roentgenogram was ordered under the impression that a so-called "infraction" was being dealt with.

The examination of the roentgenogram failed to show the characteristic changes in the end of the metatarsal bone; it was not widened in its transverse diameter and the joint line was also not wider than that of the opposite side. There were no indications of loose bodies. No special abnormality of the roentgenogram was otherwise detected except that there was an extra epiphysis at the proximal end of the fifth metatarsal of both feet. He was furnished with a metatarsal pad and this gave him relief.

Opportunity for examination occurred again in November, 1925. At this time it was noted that the thickening of the head of the metatarsal was still present; there was still some tenderness. The pad was still being worn and he was having no pain. During the summer, while at camp, he lost his pad, and his foot hurt him. A new pad was sent for this reason. Roentgenograms of both feet were again made at this time.

To my mind much interest attaches to the examination and comparison of the two sets of roentgenograms. Whereas those made in February showed no obvious abnormality except the accessory epiphysis

FIG. 1

The right foot of the patient as seen in February, 1925. The left foot was taken on a separate film and shows no demonstrable difference from this one.

at the proximal ends of the fifth metatarsals of both feet, this is not the case with the picture of the right foot made in November (Figs. 1 and 2). Examination of the films made in November shows no obvious change in the joint end of the metatarsal. The joint space is equal to that of the

left foot and there is no change in the shape of the joint surface. It is apparent, however, that the metatarsal of the right side has become thickened and more dense than the left. That this is not due to optical distortion is shown by the fact that the measurement of the third metatarsals of both sides is equal: 0.83 cm. at 2.0 from the joint surface. On

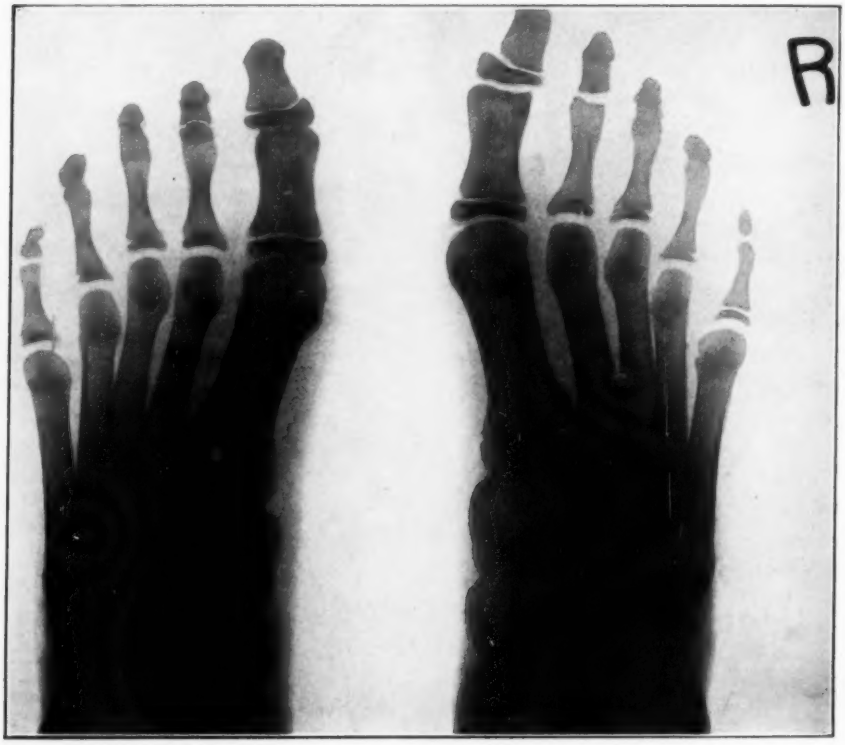

FIG. 2

Both feet of the case reported as seen in November, 1925.

the other hand, the transverse diameter of the right metatarsal bone at 2.0 cm. from the joint surface measures 1.08, whereas that of the left measures 0.91. That this is due to disproportionate growth in thickness of the second metatarsal is shown by the fact that in the picture made in February the relation of transverse diameter of the third to that of the second metatarsal is 94%, whereas in the November film it is 77%. This disproportion, amounting to 14%, is sufficient to be considered significant.

It has been mentioned that there is an increase of density of the bone in the November film as compared with that of the February film. This can be seen, by the aid of a glass, to be due to an actual change in the arrangement of the trabeculae in the head of the bone. In the February view the trabeculae run prevailingly in columns which are practically parallel and which terminate at right angles to the joint surface; in the November view this distinct arrangement can no longer be distinguished in the second metatarsal, although in the other bones of the foot there are no changes apparent. These changes are easily demonstrable in the film itself, and while they may be plainly seen in the print from which the cuts for this article are made, it is scarcely likely that such fine detail can be reproduced by the ordinary process at our disposal. The interpretation of this change in the second metatarsal, occurring within a period of eight months, is a difficult matter without more evidence than is at command. My excuse for making this report without a definite expression of opinion is that I hope it may lead to further study of similar cases and perhaps bring us to an explanation of the condition implied in the caption of this paper. This expression implies that it is my belief that the case which I am here reporting represents a very early stage of the so-called "infraction of the second metatarsal bone." It also implies that I am ready to acknowledge that simple trauma is not a satisfying explanation of the clinical and roentgenographic phenomena which have been described in this connection and by various authors. The matters of priority of publication and of the attachment of an eponymic title to the condition seem to me of little importance.

MARCH FOOT*

BY DR. MURK JANSEN, O.B.E., LEIDEN

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March foot is the well-known oedematous swelling of the metatarsal region of the foot which presents itself in persons who are made to walk beyond their strength, in military men as well as in civilians. The pain, if present, is not severe. It is often restricted to a feeling of stiffness in the mid-foot and hardly ever forces the soldier to fall out. There is no pain at all during rest, though pressure on the swollen parts may evoke it.

The swelling first presents itself on the dorsum of the foot, next on the plantar surface, though in a less degree. When increasing it spreads over the toes, but hardly ever over the tarsal part of the foot. In light cases the oedema is exclusively subfascial; in more severe cases it also becomes subcutaneous and hides from view the extensor tendons on the dorsum of the foot. Finger pressure usually leaves a slight impression. In the beginning the swelling soon disappears with rest, sometimes in a single night, and reappears with new fatigue. The supra-fascial oedema disappears relatively rapidly, but the subfascial oedema is much more tenacious.

The roentgenogram shows no changes of the bones at the outset. In the course of a few weeks, however, even thickenings on the metatarsal bones develop along their diaphyseal portion. They begin with a hazy, indefinite outline, and gradually adopt the character of a well-defined shadow. Their width shows a notable parallelism with the number of interosseous fibers which originate from the various metatarsals and their parts (see Fig. 1), so that there is never a thickening of the first metatarsal, the lateral border of the fifth, and the heads and basal portions of the metatarsals, from all of which parts no interosseous bundles arise. The medial border of the third, fourth, and fifth, from which both internal and external interossei originate, shows more considerable thickening than the lateral border of the second, third, and fourth metatarsals, from which only external interosseous bundles arise. This parallelism between the tarsal thickenings and the number of interosseous bundles arising from the bony

*Paper read at the Annual Meeting of the British Orthopaedic Association, October 24, 1925, Manchester.

parts is conceivably of great moment with regard to the rôle that is to be ascribed to the interosseous muscles in the development of the condition.

Besides these even thickenings, spindle-shaped thickenings may develop on the metatarsal bones, situated below the periosteum, as well as irregular prominences. These spindle-shaped and irregular thickenings are also limited to the areas of origin of interosseous bundles, viz., they are never observed in those parts of the metatarsals from which no interosseous fibers arise.

During or after the development of these phenomena a metatarsal fracture may occur without a preceding trauma or even a sensation of pain, so that the fracture is often a surprise both to the doctor and the patient. These fractures are apt to appear when the patient continues to take fatiguing walks. Their site is again limited to the bones from which interosseous muscles originate, i.e., the second, third, and fourth metatarsals. The first metatarsal is never fractured, and the fifth only in 0.6% of the cases. They are more frequent in the second metatarsal (54.5%, according to Muskat) than in the third (36.8%) and the fourth (2.5%), although the second metatarsal gives origin to fewer interosseous fibers than the third and the fourth, a fact which will be considered later.

Besides these symptoms, which have been studied by many investigators, we have found two more symptoms to be constant in march foot, viz., first, a cramp of the interosseous muscles, and second, phenomena of insufficiency of the foot, i.e., of flatfoot.

Every case of march foot shows resistance to passive lateral movement of the toes. This may best be demonstrated by seating the patient on a chair on top of a table so that his toes project beyond the border of the table. One of the toes,—for instance, the second,—is then moved sideways on both feet, while an assistant gently holds the adjoining toes apart. If only one foot is affected with march foot, more resistance to movement is felt on that side. The resistance to passive side movements is increased in normal feet as soon as pressure is borne on the adjoining interosseous space, but much more so in march foot. This increased resistance is felt even where pressure is not painful. Moreover, mere inspection reveals that the interossei are cramped, the toes being straighter than normal, and both dorsal and plantar flexion being limited. This limitation of movement, however, may be due partly to the swelling of the flexible parts.

It must be borne in mind that spastic flatfoot develops as a result of overfatigue to the insufficient musculature of the leg. Similarly it may be assumed that cramp of the interossei is due to excessive exertion of the

interossei in a foot with muscular insufficiency. Text books teach that the interosseous muscles are the abductors and the adductors of the toes. In walking and marching, however, they co-operate to stabilize the toes, i.e., to prevent their side movements on the round and slippery metatarsal heads. Thus it is this stabilizing function which causes their excessive fatigue and eventually also the spasm.

The following figures may illustrate the above symptoms:

Note parallelism between the number of interosseous fibers and the swellings of soft and bony parts.

FIG. 1

The place of origin of the musculi interossei, i.e., of the seven muscles, whose spasm is to be made responsible for march foot.
4 M^1 interossei externi.
3 M^1 interossei interni.
The interosseous muscles determine the localization and the intensity of the thickenings of the periosteum.

The opinion on the nature and the cause of the phenomena in march foot varies widely:

Some authors (Breithaupt, Weinbach) adopt as the cause of march foot inflammation of tendon sheaths and ligaments, phenomena which do not as a rule occur in the condition.

Others (Kirchner, Schulte, Thiele, Muskat) assume metatarsal fracture to be the cause—a symptom which occurs only in a small number of cases,

and, if at all, only in the later stages. Moreover, it should be remembered that even if a fracture were demonstrable in all cases it cannot be made responsible either for the oedematous swelling of the whole metatarsal region or for the thickenings of adjoining metatarsals.

Others again (Pauzat, Poulet, Thalwitzer, Momburg) attribute a

FIG. 2

Right march foot of Private A. S. (13/3/1913).

FIG. 3

Same man as Fig. 2, 3½ months later (5/7/1913).

Fig. 2. Note that here, as in some of the following cases, there is no fracture. There is swelling over the 2nd and 3rd interosseous spaces. Superficial venae of the dorsum of the foot are dilated. The 2nd and 3rd metatarsals are both thickened, especially on the mesial side, more so in the right foot than in the left. The right 5th metatarsal shows even thickening on the mesial side with an ill-defined outline. Active dorsal flexion of all toes is limited. Passive lateral movements of the toes meet with undue resistance. Pressure on the 2nd and 3rd interosseous space elicits violent pain and increases the resistance to passive lateral movements of the toes. Pressure on the 4th space is painless and does not impede passive lateral movements of the 4th and 5th toes. Pressure on the metatarsal heads is painless in all directions.

Fig. 3. A fracture has developed in the right 3rd metatarsal. The callus shows characteristic spots due to limesalt deposits. Moreover, the thickenings have increased, especially on the 2nd metatarsal of the right foot, and both 2nd and 3rd of the left, chiefly on the mesial side.

Note parallelism between the number of interosseous bundles and the swellings of soft and bony parts.

causal function to the thickenings of the metatarsals,—a symptom which develops only in the later stages, after the characteristic oedema of the foot has been present for some time, and which does not appear at all when proper treatment is given.

Still others (Blecher, Tobold, Siebert and Simon, Tiedeman, Bähr) search for the cause of march foot now in one, now in another of these symptoms, and thus increase the confusion.

FIG. 4

Right and left march foot of Private V. D. B. (20/6/1913).

FIG. 5

Same man, 1 month later (24/7/1913).

Fig. 4. 2nd and 3rd metatarsals are thickened on both sides, chiefly mesially, and more in the right than in the left foot. The mesial thickenings in the right foot are irregular and have an ill-defined outline. (Hydropic swelling of the periosteum.)

Fig. 5. Now the mesial side of the 4th metatarsal appears to be also thickened in both feet, and of the 5th in the left foot. The changes of the 2nd and 3rd exceed those of the other metatarsals, as in all other cases presented. There is no fracture. The outline of the swellings is more definite than before.

FIG. 6

Right and also slight left march foot of Private J. C. (27/2/1913).

FIG. 7

Same man as Fig. 6, 4 months later (2/7/1913).

Fig. 6. The outlines of the 2nd, 3rd, and 4th metatarsals are ill defined. There is even thickening of the lateral border of the 4th and the mesial border of the 5th metatarsal. The thickenings on the left are doubtful as yet.

Fig. 7. The thickenings are now evident in both feet on 2nd, 3rd, and 4th metatarsals and the mesial side of the 5th. There are irregular thickenings on the mesial side of the 2nd metatarsal in both feet. The left 3rd metatarsal seems to be fractured. There is subperiosteal, spindle-shaped swelling: hemorrhage or callus. Note that the first metatarsal in this case, as in all others, is free from thickenings.

Some authors finally call march foot a "periostitis," thus merely adding a word to the phenomena which fails to deepen our insight.

To us the primary agent in march foot seems to be the spasm of the interosseous muscles: The interossei normally allow the flow of lymph and blood through perforating blood and lymph vessels. In their spastic condition, however, this flow of lymph and also of venous blood is impeded.

FIG. 8

Left march foot of Private V. I. S. (28/2/1913).

FIG. 9

Same man, 5 months later (24/7/1913).

Fig. 8. The thickenings of the metatarsals are doubtful as yet, but the three middle toes show resistance to passive side movements. Thus the interosseous spasm appears to precede the bone thickenings. The first pain was felt on the day before the roentgenogram was taken. Here, as in all other cases, all symptoms of weak feet: prominent navicular, valgus position of calcaneus, callosities under ball of foot, and pain to pressure on the characteristic spots (inner side of lower astragular joint, plantar side of astragalo-navicular, naviculo-cuneiform, and tarso-metatarsal joints) are present.

Fig. 9. The left 3rd metatarsal is fractured and shows spindle-shaped thickening with calcareous deposits (callus). Moreover, 2nd and 3rd metatarsals show distinct thickenings.

Thus the hydrostatic pressure in the adjacent tissues is increased both in the distensible and in the bony parts. The flexible parts respond with increase of their bulk. The periosteum, which also is distensible, shares in the swelling, which shows itself in the roentgenogram as an ill-defined thickening. Thus there is brought about an even thickening of the periosteum, which appears gradually to change into bone, forming a well-defined and lasting thickening. That these thickenings are proportional to the number of contiguous muscle fibers points to the fact that the stasis of blood and lymph is proportional to the adjacent number of cramped muscle

fibers. Furthermore it seems rational to assume that sometimes during the oedematous swelling a sudden pull of interossei fibers may lift the periosteum from its bony layer and cause a hemorrhage which presents itself in the well-known spindle-shaped thickenings, or also cause a rent in the periosteum which gives rise to the irregular swellings. It is in conformity with this assumption that in places where no muscle bundles arise, i.e., in the head as in the base of the metatarsals, the thickenings of the metatarsals are absent.

FIG. 10 — Right and left march foot, more marked on the left, of Private A. d. V. (12/3/1913).

FIG. 11 — Same man, 3½ months later (2/7/1913).

Fig. 10. 2nd and 3rd metatarsals are notably thickened. Outlines of right 2nd and 3rd are ill defined. There is no sign of fractures. First pain 2 days ago while playing football. Serious flatfoot: navicular bones almost touch the ground. Pressure on the interosseous spaces enhances passive resistance to side movements of the toes (here as in all other cases). 2nd metatarsal is very painful to pressure, as well as 2nd interosseous space. No pain to pressure on other interosseous spaces.

Fig. 11. 3rd metatarsal fractured on both sides. Moreover, 2nd metatarsal shows thickening in both feet.

The bony parts, unlike the flexible parts, cannot respond to the increased hydrostatic pressure with expansion. Hydrostatic pressure acts equally in all directions, and it is well known that bone cannot withstand pressure which acts at right angles to the directions for which it has been built. In those directions it gives rise to absorption of lime salts and a thinning out of its constituent parts. This may account for the brittleness which some of the metatarsals develop, viz., those which give origin to interosseous bundles, and for the enhanced possibility of fractures ensuing imperceptibly.

That the second metatarsal bone fractures more frequently than the

third and the fourth, although giving origin to fewer interosseous bundles, may be due to the fact that it is longer. It may be remembered that normally the metatarsal heads, forming a transverse arch, will all touch the ground equally when the heel is raised to a certain height. In weak feet, however, to which we found the development of march foot restricted, the transverse arch is sunken and the metatarsal heads touch the ground equally

FIG. 12

Miss S. Partial march foot.

There is hard oedema over the 4th interosseous space. The 4th M. interosseus externus appears to be in spasm. It forces the small toe into abduction. The spasm diminishes during rest. Pressure on the 4th interosseous space elicits the spasm and forced abduction. Besides partial march foot there is spasmodic flatfoot.

only as long as the heel touches the ground. As soon as the heel is lifted, however, the longer metatarsals—i.e., the second and third—are thrust against the ground with greater force than the shorter ones. The callosities on the skin below their heads, characteristic of weak feet, bear testimony to this increased force. Thus it is that on becoming brittle they are the first to fracture.

Cases of partial march foot which we have observed may tend to confirm the assumption that spasm of the interossei is to be made responsible for the condition. Figure 12 is drawn from a housemaid with a marked

swelling which was restricted to the fourth interosseous space. As she took off her stocking, the fourth and fifth toes stood in maximal abduction, which decreased in a few moments, without, however, disappearing altogether. Pressure on the swollen space promptly elicited renewed abduction and increased the pain for which the patient came to consult us. In another case of partial march foot the swelling was restricted to the first interosseous space. The second toe persistently assumed the position of tibial abduction under the big toe, for which the patient asked our advice.

Thus the swelling of the flexible parts in march foot appears to be dependent on the spasm of the interosseous muscles. With the spasm it is the initial symptom of the condition and varies with it in intensity as well as in localization. It precedes the various thickenings of the periosteum as well as eventual fractures.

It is generally known that overfatigue in weak feet will lead to spasmodic flatfoot. Similarly overfatigue appears to be able to produce spasm in the interossei of weak feet.

Whether the muscles of the leg or those of the forefoot will be seized with the spasm will probably depend upon the amount of energy demanded of them, i.e., depend upon the personal characteristics of the gait. Persons who bear much of their weight on the ball of the foot and thus make forcible use of the toes will more easily contract march foot than those bearing the weight nearer the heel.

Summarizing, we may say that march foot is due to overfatigue in a weak foot, which causes spasm of the interosseous muscles, stasis of blood and lymph, swelling of the flexible parts, thickening of the periosteum, and brittleness of the bone tissue of the metatarsals; eventually also fracture. March foot is to the mid-foot what spastic flatfoot is to the lower leg. It is *antepes contractus* or spastic mid-foot.

Thus march foot is one of the scourges which may be inflicted on persons with weak feet. It should be remembered that but for rare exceptions flatfoot is one of the four characteristic symptoms of general muscle weakness (viz., weak feet, prominent abdomen, round shoulders, bluish and moist hands and feet). In other words: in the man with weak feet (resp. march foot) the musculature, which demands most of all tissues, viz., 43 per cent. of the power of growth, has lagged behind the other tissues in development. Thus march foot testifies a state of enfeeblement of the individual, for which injurious agents in his life-history or in that of his parents or forefathers have to be made responsible. And an increase of march feet, as of weak feet in an army, should raise the suspicion of a de-

crease of strength of the nation and be an inducement to search for injurious agents acting on the nation.

The fact that the metatarsal bones may be made brittle through stasis of blood and lymph may find application in other pathologic conditions of the bone substance. It leads to the suggestion that in the initial stage of coxa plana the lateral displacement of the femoral head on the neck may lead to brittleness of the head, if it is attended by compression of blood and lymph vessels, and may thus enhance the possibility of the characteristic impression fracture which Axhausen has described, even without blood vessels being torn. Similarly it should be considered, whether in the impression fracture in Köhler's disease of the second metatarsal, as in Köhler's flattening of the navicular bone of the foot, and in the compression of vertebral bodies first observed by Calvé and by Brackett, reasons for preliminary stasis of blood and lymph may be traced.

At all events experiments on the effect of stasis of blood and lymph on bone tissue may yield an insight into those hitherto obscure conditions.

LITERATURE CONSULTED

Siebert and Simon: Die Fussgeschwulst und ihre Bedeutung für das Deutsche Heer. Deutsche Ztschr. f. Chir., Bd. 30, H. 3 u. 4, S. 403, 410, 408.

Nasse und Borchardt: Handbuch der praktischen Chirurgie von Bergmann und v. Bruns. 3 Aufl., Bd. 5, S. 947.

Thalwitzer: Zur Aetiologie der Fussgeschwulst. Deutsche militärärtzl. Zeitschrift. 1902, S. 435, 438, 439.

Bähr: Die Fussgeschwulst und ihre Beziehungen zum vorderen Frontalgewölbe. Deutsche Ztschr. f. orth. Chir., 1913, Bd. 32, S. 318 u. 319.

Breithaupt: Zur Pathologie des menschlichen Fusses. Med. Ztschr., 1855. 24 Jahrg., Nr. 36, 37, S. 169.

G. Thomas Morton: A Peculiar Affection of the Fourth Metatarsophalangeal Articulation. Am. Jour. Med. Sciences, Jan., 1876.

Weisbach: Die sog. Fussgeschwulst. Syndesmitis Metatarsea—des Infanteristen infolge von anstrengenden Märschen. Deutsche militärärtzl. Ztschr., 1877, S. 552.

Pausat: De la périostite ostéoplasique des métatarsiens à la suite de la marche. Arch. de méd. et de pharm. milit., 1887, S. 337.

André Martin: Inflammation périosto-arthritique du pied à la suite des marches. Arch. de méd. et de pharm. milit., 1891, T. XVIII, S. 336.

H. Nimier: De l'entorse métatarsienne chez des fantassins. Arch de méd. et de pharm. milit., 1893, S. 61.

Rittershausen: Milit. Wochenblatt, 5 Sept., 1894, Nr. 75.

Kösting: Deutsche milit. ärtz. Ztschr., S. 404.

Stechow: Fussödem und Röntgenstrahlen. Deutsche milit. ärtzl. Ztschr., 1897, S. 465.

Stechow: Lehrbuch für militärhygiene von Durns und Kirchner. S. 470.

A. Kirchner: Ueber das Wesen der sog. Fussgeschwulst. Wiesbaden. Bergmann. S. 898.

A. KIRCHNER: Die Fussgeschwulst. D. militärärtzl. Ztschr., 1899, S. 79.
SCHULTE: Die sog. Fussgeschwulst. Langenbeck's Archiv., 1897, Bd. 55, S. 87 u. 884.
v. BERGMANN u. v. BRUNS: Handbuch der praktischen Chirurgie. 3 Aufl., Bd. 5, S. 946.
NARSE u. BORCHARDT: Frakturen der Metatarsalknochen und Phalangen.
A. KIRCHNER: Die Aetiologie der indirekten Metatarsalfraktur. Langenbeck's Archiv. 1905, Bd. 77, S. 242.
BLECHER: Entstehung der Fussgeschwulst. Deutsche mil. ärtzl. Ztschr., 1903, 32 Jehrg., S. 4 u. 19.
OTTO THIELE: Weiteren Beitrag zur Frage nach der Ursache der sog. Fussgeschwulst. Deutsche mil. ärtzl. Ztschr., 1900, 29 Jahrg., Heft 3, S. 129 ff.
BLECHER: Fussgeschwulst, Knochenbruch, u. Knochenhautentzündung.—D. milit. ärtzl. Ztschr., 1902, S. 321.
TOBOLD: Zur Kasuistik der Mittelfussknochenbrüche. D. milit. ärtzl. Ztschr., 1903. S. 573, 584.
NION: Zur Statistik der Mittelfussknochenbrüche. D. milit. ärtzl. Ztschr., 1903, S. 200.
SCHUMBURG: Hygiene des Marsches und der Truppenunterkunft. Dritter Vortrag des Cyclus "Aertzliche Kriegswissenschaft."
G. MUSKAT: Die Brüche der Mittelfussknochen in ihrer Bedeutung für die Lehre von der Statik des Fusses. v. Volkmanns Samml. klin. Vortr. Nr. 258, S. 12.
TOBOLD: Mitteilungen von der Röntgenitation. D. milit. ärtzl. Ztschr., 1903, S. 576.
SCHIPMANN: D. med. Wochschr., 1899, Nr. 20.
E. MAILLEFERT: Ein Fall von indirekten Bruch eines Mittelfussknochens. Münch. med. Woch., 1900, S. 1237.
SCHULTE: Archiv f. klin. Chir., 1891 (Zitiert nach Blecher).
BLECHER: D. milit. ärtzl. Ztschr. 1903, 32 Jhrg., S. 19.
H. HAMANN: Ueber subkutane Frakturen der Metakarpal- und Metatarsalknochen, mit besonderer Berücksichtigung der sog. militärischen Fussödems. Diss. Greifswald, 1902.
A. POULET: Arch. de méd. et de pharm. milit., 1888, T. XII, S. 245.
A. POULET: De l'ostéopériostite rhumatismale des métatarsiens au 3ième régiment de Zouaves. Arch. de méd. et du pharm. milit., 1888, S. 254.
BUSQUET: Revue de Chirurgie, 1897 (Zitiert nach Boisson u. Chapotot).
BOISSON, CHAPOTOT: Le pied forcé, étude sur la nature et la pathogénie des lésions de l'avant-pied, provoquées par la marche chez les fantassins. Arch. de méd. et de pharm. milit., 1899.
MOMBURG: Die Entstehungsursache der Fussgeschwulst. D. Ztschr. f. Chir., 1904, Bd. 73.
BLECHER: Zur Entstehung der Fussgeschwulst (Entgegnung auf die Veröffentlichung von Stabarzt Momburg). D. Ztschr. f. Chir., 1904, Bd. 74, S. 350.
E. TIEDEMANN: Ueber die Häufigkeit u. das Wesen der Fussgeschwulst. Diss. Berlin, 1904.
MARTIN FISCHER: Das Oedem. 1910. (Preisschrift des Nathan-Lewis-Hatfield Preises, 1909, des College of Physicians in Philadelphia, U. S. A.).
P. POIRIER: Traité d'anatomie humaine. T. II, 1 Fascic.: Myologie. S. 281.
BERGMANN-BRUNS-MIKULICZ: Handbuch der prakt. Chirurgie, Bd. 4, I, S. 409.
MURK JANSEN: Die Fussgeschwulst und ihre Ursache. F. Enke. Stuttgart, 1915. Also: D. Ztschr. f. orth. Chir., Bd. 35.

FRACTURES OF THE FEMUR IN CHILDREN

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When the femur is broken in patients under fifteen years of age the break is almost always in the shaft. Fractures of the neck are very rare. Separation of the upper epiphysis may occur as analogous to a fracture in this region, but this is also rare. In the Los Angeles General Hospital records for the past four years one such case was found. This occurred in a child of twelve years and was a complete separation, the neck being completely displaced over the upper rim of the acetabulum. One case of true fracture of the neck was found in the literature, being reported by Parker. This occurred in a boy of nine who walked for three weeks after a hip injury and was then diagnosed by roentgenogram. Another true fracture of the neck in a boy of ten was recently observed by the author, but it is not included in the series in this paper.

Intertrochanteric fractures are also rather uncommon in children, probably because the bone here is spongy and yielding. Supracondylar fractures and separation of the lower epiphysis occur more often than lesions at the proximal end of the bone, but even these are not often encountered. There may be a separation of the epiphysis from one condyle and supracondylar fracture of the other at the same time, as is shown in one case in this series.

This infrequency of fractures near either end of the femur is in keeping with the findings regarding other bones in children. For instance, a true Colles fracture is almost never seen in patients under twelve; the break occurs a little higher on the shaft of the radius. All this is probably due to the fact that the soft yielding structure of the epiphyseal region renders the bone less brittle so that it only bends. With the same mechanics of force the break which would occur very close to the end of the bone in an adult takes place in a child a few centimeters farther from the end.

In this series of thirty-one cases all were of the shaft except one intracondylar. Twenty were boys and eleven girls. One was a baby of four months, one three years; eleven were from three to six years old, eleven from six to nine, five from nine to twelve, one fourteen, and one fifteen. An interesting and significant fact is that fourteen were caused by automobile accidents. Eight occurred in falls at play, either from a height or on the ground. One child was struck by a train, and in eight cases the cause

could not be learned. Probably it is merely a coincidence that twenty-two out of the thirty-one cases were in the left leg.

The femur usually breaks near the middle. Seventeen of the fractures were in the middle third, nine in the upper, and four in the lower third. About the same proportion is noted in other series in the literature. For instance, a series by Conwell shows 50% in the middle, 23% in the upper, and 27% in the lower third. Bloch's statistics from over five hundred cases in France show the middle third predominant. Cole's series of thirty-one cases shows twenty-one in the middle third. David reports seventy-five cases, of which forty-five were in the middle third. All these show that the middle third is the most common site, the upper third next, and the lower third least common.

The type of fracture most often encountered in this series was the transverse, with nineteen cases. Eleven were oblique and one spiral. Two of the transverse and four of the oblique were more or less comminuted, but the comminution is not regarded as a fundamental class, and as a rule can be disregarded in treatment. In reviewing seventeen more cases farther back in the hospital records (but not under my treatment) the transverse type was still found most frequently, eight being of that type, six oblique, and three spiral. This is not in accord with some text books on surgery, in which the oblique type is said to be the most common. The difference may be due to the fact that all patients in this series were under fifteen, while the text book statistics include all ages.

The position which the fragments may take when the fracture occurs is an interesting study. For purposes of simplification it is best to speak always of the proximal fragment in its relation to the distal. It may take any one of eight positions, namely: anterior, antero-lateral, antero-mesial, posterior, postero-lateral, postero-mesial, lateral, and mesial. The most frequent position found in this series was the antero-lateral, which occurred in eleven cases. Three others were anterior and four antero-mesial, making a total of eighteen in all the anterior positions. Only seven were posterior, while in four the proximal fragment was found in lateral displacement and in one mesial, without any antero-posterior displacement in either case. The displacement, of course, is due to muscle pull after the rigidity of the limb is destroyed. The flexors of the hip, chiefly the iliopsoas muscle, being stronger than the extensors, the proximal fragment is usually pulled anteriorly. Then, since the adductors are inserted mostly in the distal fragment, the abductors, chiefly the gluteus medius and minimus attached to the great trochanter, tend to pull the proximal fragment laterally. Add to this the strong gastrocnemius which can always be de-

pended upon to pull the distal fragment posteriorly, and it is easy to explain the preponderance of anterior and antero-lateral positions of the proximal fragment. If the fracture is in the upper third there will be external rotation of the leg because the external rotators of the thigh are much in excess of the internal rotators, there being only three of the latter,—namely, the tensor fasciae femoris, gluteus minimus, and gluteus medius.

If all these facts are kept in mind when one undertakes the reduction of a fractured femur the reduction may be accomplished more easily. These facts also explain why the Bryan perpendicular extension method usually gives the best reduction in children. By this method we get at once a flexion and abduction of the thigh, thus bringing the distal fragment into line with the flexed and abducted proximal fragment. It is said to have been first used in 1898 at the Johns Hopkins Hospital and since then has been the method of choice for children.

In this series the overhead extension was used in twenty-one cases. In fifteen of these a good reduction was obtained, but in six the result was not satisfactory and the fracture was reduced under anesthetic and a spica cast applied. In one of these six an outward bowing had resulted because the child walked too early and open reduction had to be done. A fairly good alignment was maintained in a spica without internal fixation of any kind, but a shortening of two cm. persisted. This child was seven years old, and when last seen, twenty months after the fracture, she had not made up any of this shortening. Of the fifteen satisfactory overhead extension cases, three had spica casts applied after the extension was removed and kept on from two to three weeks as a protection against falls. In the remaining twelve, the extension was removed in from two to four weeks, depending on the age, following which massage and motion were carried on for two or three weeks more before weight was allowed.

The horizontal Buch's extension was tried in only two cases and failed to produce a satisfactory reduction in each case. This method was introduced by Gurdon Buch of New York in 1861, but in Garrison's History of Medicine it is stated that Guy de Chauliac, a French physician who lived from 1300 to 1368, treated fractures of the femur by means of weights and pulleys. It was the most popular method since its introduction by Buch until Cushing began to use spica casts in 1898. With the same amount of weight, much more can be accomplished with the hip sharply flexed than in the extended position. These two patients were eight and ten years old and both had to have open reductions, as will be explained below.

To obtain a union in any fracture, which means formation of callus, it is not necessary to have the fragments rigidly immobilized including

the joints above and below. In fact, a callus will form more quickly and more abundantly if some motion is allowed. This is well demonstrated in specimens of fracture found in birds and wild animals, an excellent collection of which may be seen at the Army Medical Museum in Washington. Many of these show union, presumably without any treatment whatever, but the alignment and length, of course, are very poor.

The chief problem, then, is to maintain the original alignment and length of the femur, and if this can be done without rigid fixation, so much the better. In cases of wide displacement and comminution, direct application of the extension to the condyles of the femur is advisable. One boy of fifteen had a double fracture in the middle third, the intermediate fragment about five cm. in length and completely out of contact with both the proximal and distal fragment. Alignment in the antero-posterior plane was good, but a lateral view showed a distance of about fifteen cm. from the end of the proximal fragment displaced anteriorly to the end of the distal fragment, with the intermediate fragment hanging, as it were, in mid-air between them. Calipers were applied to the condyles of the femur, and with knee and hip flexed each at about 130 degrees a weight of fifteen pounds was hung on. With this direct extension a very fair alignment in both planes was obtained. After about a week a spica cast was applied because one tong of the calipers was found to be in the epiphyseal line. The direct extension was not removed until the cast was on, but even so, there was some loss in length and alignment, although it was still good enough to give a good functional leg.

The Hodgen splint, introduced by John Thomas Hodgen of Kentucky, who lived from 1826 to 1882, is a good device for holding a femur with hip and knee flexed, but in my hands the Thomas splint with the Pierson attachment for the leg below the knee is more adjustable to the size of the patient.

In the overhead suspension I see no reason for suspending both legs. In fact, it seems that better abduction can be obtained by tying up only the fractured one. Also more weight and counterweight is available by the one-leg method, because with the sound leg holding up part of the body weight, that much of the counterweight of the body is lost. Enough weight is hung on to raise the patient's buttock off the bed, the number of pounds, of course, varying widely, from five to twenty.

Four cases out of the thirty-one required open reduction, one because of union with over-riding, one because muscle interposition prevented reduction, one because of union with outward bowing mentioned above, and one because the distal fragment was short and locked in bad displacement. Internal fixation was used in only two of these, a Lane plate in

one and kangaroo tendon in the other. The patient in whom the distal fragment was locked was a boy of fourteen with the fracture line running from above the internal condyle outward and downward between the condyles and into the articular surface. The outer condyle was not broken. Instead, the outer epiphysis was displaced inward and backward. This fracture could not be reduced until incisions were made over each condyle and the epiphyseal fragment unlocked from the shaft by prying with an osteotome. The inner condyle was then lashed to the shaft with kangaroo tendon through drill holes.

Six cases were reduced under anesthetic within thirty-six hours and a spica cast applied. These were all transverse fractures in which it was thought possible to get the fragments into end-to-end approximation by manipulation. To insure a good result the fragments must be made to lock, thus maintaining the normal length. In one of these there was a shortening after union of 1.5 cm., in another 0.5 cm., in four no shortening, and one could not be traced.

A tabulation of measurements after union in this series showed one cm. lengthening in one case, no shortening in ten cases, 0.5 cm. or less in four cases, 0.6 to 1 cm. in seven cases, 1.5 cm. in four, and 2 cm. in two cases. Four could not be traced. All the cases with the greatest shortening had oblique fractures. Joint function in sixteen cases was normal. In one case there was a little awkwardness in running. In two cases the patients are not yet ready to walk, and twelve patients could not be traced.

In trying to follow up these cases it was especially desired to observe whether any made up shortening by growth, but no such case was found. In one case a shortening of two cm. had persisted for twenty months. However, many authentic cases are reported in the literature and it is probably a coincidence that in this small series none was found. Cole, who has called attention to this compensatory lengthening, thinks it is due to stretching the soft bone. A stimulation of growth on demands of function according to Wolff's law of bone development seems to me a more rational explanation. The working of Wolff's law, adaptation of structure to function, was noted in many of these cases in the smoothing out of extra comminution fragments so that in the end any extraneous bone unnecessary for the strength of the shaft was absorbed without a trace being left.

SUMMARY

The overhead extension is the most dependable method for oblique fractures and the method of immediate reduction and cast under ether is usually best for the transverse type.

A leg not more than one cm. shorter than the sound leg with good alignment should be the goal of treatment.

Open reduction is not often indicated.

REFERENCES

Bloch: Revue d'orthopédie, September, 1922, page 447.
Cole: Archives of Surgery, November, 1922, page 702.
Conwell: Surgery, Gynecology, and Obstetrics, January, 1925, page 112.
David: Archives of Surgery, September, 1924, page 438.
Parker: American Journal of Orthopaedic Surgery, March, 1918, page 208.

RENAL RICKETS*

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From the Orthopaedic Service and Medical Division, Ancoats Hospital, Manchester

Renal rickets is a disease not mentioned in medical text-books. The first association of albuminuria with rickets was made by Clement Lucas, who in 1883 stated that albuminuria and late rickets were too frequently connected to be matters of chance. Lyon, in 1901, recorded a case of infantilism associated with renal fibrosis. Except for these there is no record of the condition until 1911, since when Morley Fletcher, Parsons, Miller, Sutherland, Naish, Weber, Barber, Paterson, Cameron, Feiling and Holyoak, and Watson Wemyss have written on the subject.

Naish,[1] in 1912, summarizing the literature at that time, stated that he was aware of eight cases which showed infantilism, polyuria, polydipsia, albumen in the urine, and a negative Wassermann. In five of these eight there was rickets of late origin.

Barber,[2] in 1921, defined the condition as one of stunted development associated with bone deformities of the late rickets type, due to an insidious chronic interstitial nephritis of obscure etiology.

Study of the literature shows that a clinical picture has been fairly well recognized of late years. This is one of stunting associated with rachitic deformities, usually of late onset, and is reported as occurring both with and without demonstrable kidney disease.

The death in Ancoats Hospital in 1921 of two rickety persons from uraemia focused attention on the condition, and since the summer of 1922 all patients with rachitic deformity, who from pallor or other reasons were thought to be suffering from renal disease or who were unduly stunted for their age, were admitted for special investigation. These were in the main adolescents.

The method of investigation included case notes; general roentgenographic examination of all bones; blood urea estimations; urea concentration tests; the Loewi mydriatic test for pancreatic insufficiency; the Goetsch adrenalin injection test for hyperthyroidism; the Wassermann reaction; a photograph, and, where possible, examination of post-mortem material.

*Read before the British Orthopaedic Association at Manchester, October 24, 1925.

Twenty-four cases were investigated.

I wish to report in detail one typical case and then briefly to present the results of the inquiry.

(Fig. 1.) The patient, aged 18, had had some bowing of the legs since the age of four. This was not very marked and did not progressively in-

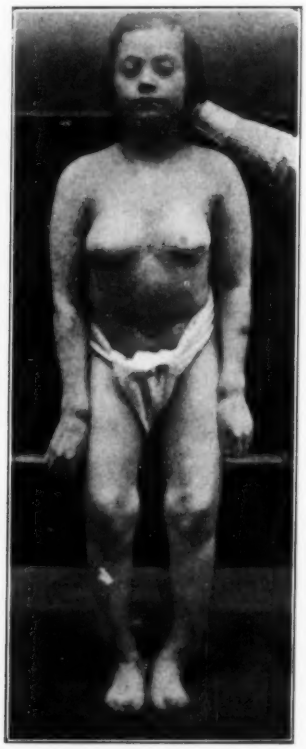


FIG. 1

Patient, aged 18, with renal rickets.

crease until the age of 15, when growth ceased and the legs began to bow further. She appeared pale and stunted; the face was of the large white type, and there was fullness round the eyes and a tired expression. Her height was 4 ft. 2 in. (the normal for the age is 5 ft. 5 in.). She was well nourished and weighed 5 stone, 10 pounds. The weight did not vary during the five weeks in hospital, April to May, 1923. General physical

examination was negative. There was neither polyuria nor polydipsia. The head was square, with frontal prominence, and the teeth were poor. There was no rib beading. In Figure 1 may be seen the enlargement at the lower ends of the radius and ulna; the legs show antero-lateral bowing of both femora and of both tibiae and fibulae, more particularly in their lower third. There was 30° permanent flexion at the hip joint and movements here were limited in range. On standing a well-marked lumbar lordosis was seen. Muscle power was good and there was no obvious wasting. Sensation and reflexes were normal. The gait was waddling. The stance was a little atonic and some support was needed in taking the photograph.

Special Tests: Blood Urea: = 95 milligrammes per 100 c.c.

Urea Concentration Test:—

Specimen 1.	Before giving urea	90 c.c.	= 0.9%
" 2.	One hour after	80 c.c.	= 0.9%
" 3.	Two hours after	70 c.c.	= 1.0%

Loewi test, Goetsch test, and Wassermann reaction, negative.

The urine had a specific gravity of 1010, was acid in reaction, and albumen was always present. Nine months later the urine was acid, had a specific gravity of 1004, and contained albumen. The blood urea was 50.1 milligrammes per 100 c.c.

The urea concentration test gave:

Specimen 1.	Before giving urea	214 c.c.	= 0.53%
" 2.	One hour after	124 c.c.	= 0.68%
" 3.	Two hours after	129 c.c.	= 0.75%

As a routine a detailed description of the roentgenograms has been written, covering in this case some six pages of type script. This is not presented here, but attention is called to some characteristic features.

In Figure 2 the skull shows gross and uniform thickening of the bones of the vault. The pituitary fossa is normal.

In Figure 3, the shoulder, there is here some rarefaction, the metaphysis is wider than normal, is blurred, and of coarse, porotic appearance.

In Figure 4, the wrist and hand, notice the rachitic changes at the epiphyseal lines. The metaphyses are wider than normal, have a well-marked trabecular appearance, and the cortex cannot be picked out over the blurred zone which immediately bounds the epiphyseal line. About two inches above the lower end of the radius can be seen the line of an old oblique fracture, and the whole hand is slightly deviated to the inner side. The phalanges show a semi-cystic porotic condition, and in the first and second fingers the sides of the bone are less dense than the center, producing the appearance of a contained outline.

FIG. 2
Skull of patient seen in Fig. 1.

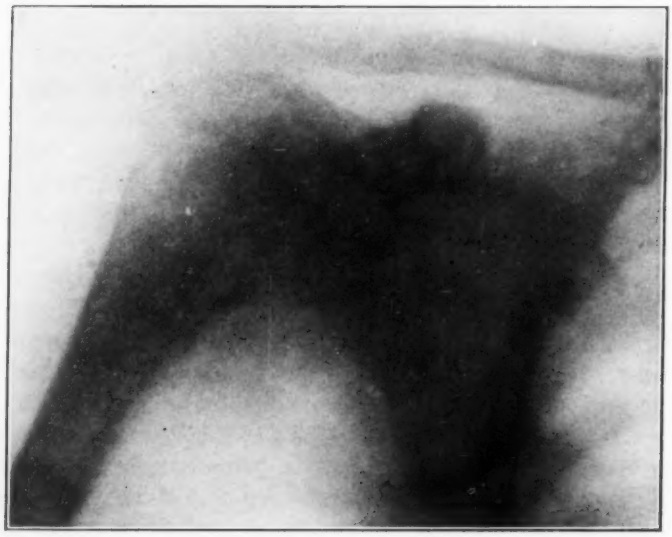


FIG. 3
Radiogram of shoulder of patient seen in Fig. 1.

In Figure 5, the tibia and fibula, note the marked anterior curvature. On the concave side the cortex thickens and in the tibia condensation of bone extends right across the medulla.

There is in the tibia a transverse fracture extending half way across the bone and at right angles to its long axis.

FIG. 4

Radiogram of hand of patient seen in Fig. 1.

As a whole the roentgenograms show mild rickets with general rarefaction and localized metaphyseal porosis.

Turning now to the results of the inquiry:—

From the urea tests of the twenty-four cases, eight were found to show definite evidence of renal inefficiency, about 33%, and to these cases a diagnosis of renal rickets has been applied. Similarly renal inefficiency was suspected in thirteen, or 54%, and a diagnosis of suspected renal rickets has been applied to these.

In renal rickets the urine is pale, of a low specific gravity, usually

below 1010, and contains albumen, but albumen is not essential to the diagnosis. Such a urine is typical of chronic interstitial nephritis. Established polyuria and polydipsia, though stressed by others, were not com-

FIG. 5

Radiogram of tibia of patient seen in Fig. 1.

mon. Nephritic symptoms and oedema were a rarity. Pallor was present in greater or less degree in every case, and it was a striking feature in those with definite renal inefficiency. The cardio-vascular changes which accompany chronic interstitial nephritis were not present and the blood pressure was normal or below the normal. The Loewi and Goetsch tests and Was-

sermann reactions were negative. The age of onset of deformity was similar to that of late rickets and lay about puberty, though at this time there may be only an exacerbation or recrudescence of previously existing deformity. Other observers have found the sex incidence of similar cases of deformity associated with nephritis to be evenly divided between males and females. In my cases there was a great preponderance of females. There was stunting without infantilism and the patients were usually well nourished. Sexual development was present, although there may be some delay in its development. General physical examination was negative. The type of deformity was that of late rickets. In all cases there was a pronounced degree of muscular asthenia. This was not accompanied by any marked degree of muscle wasting. No fibrillary twitchings were noted and the reflexes were normal. One constant and characteristic feature in connection with this asthenia was that when tested in bed the power of muscular contraction against a resistance was good, but yet the patient was unable to stand or walk. It is suggested that contractile tonus in these cases is normal, but that plastic tonus is deficient. The patients stand typically in an atonic posture, with the knees and hips flexed, the shoulders drooping, the head thrust forward, and the anterior abdominal wall grooved. The gait was of a waddling type, the patients being scarcely able to lift the feet off the ground. The quadriceps extensor group seemed particularly affected and the patients tended to throw the leg from the hip by a swing of the body, mounting stairs being especially difficult. Signs of hypo-thyroidism were occasionally found. An odor as of stale urine hung about certain of these patients, and excoriation and intertrigo of the external genitals was of sufficient frequency to be remarkable. In three cases there was brownish pigmentation of the skin, general in distribution.

A roentgenogram typical of renal rickets can be described, the general features of such a picture being deformities of the long bones of the rachitic type, a general rarefaction, changes at the epiphyseal lines characteristic of rickets, a tendency to excessive deposition of poorly calcified bone under the periosteum, frequent occurrence of split fractures generally running at right angles to the long axis of the bone.

The characteristic feature of this picture is that the rachitic changes are in the background and that the chief alteration from the normal is a hazy woolly porosis in the metaphysis.

Several points of detail are worthy of consideration. In the skull the pituitary fossa was always found to be normal: in two cases a remarkable thickening of the bones of the vault has occurred. In the wrist in

several cases ossification has proceeded irregularly and there is apparent fusion of the wrist bones. (Figure 6.) In the phalanges a semi-cystic porosis was found, and the degree of alteration in the phalanges is a good guide as to the severity of the disease. The pelvis, scapulae, vertebrae, and feet are usually unaffected.

The X-ray picture is one which is recognizable and may be taken as

FIG. 6

Radiogram of wrist epiphyses typical of renal rickets. Fusion of wrist bones.

characteristic, but it does not appear to be possible to claim that it is a separate entity. It is that of a type of rickets in which one of the pathologic elements—the change in the metaphysis—predominates.

The organs from three cases of renal rickets were examined. The kidneys present the changes characteristic of chronic interstitial nephritis. In the thyroid glands the vesicles are large and full of colloid and lined by a single layer of flattened cubical cells. From the histologic appearances it is deduced that their functional activity is of a low order. The suprarenal glands show thickening of the capsule of the gland and a definite

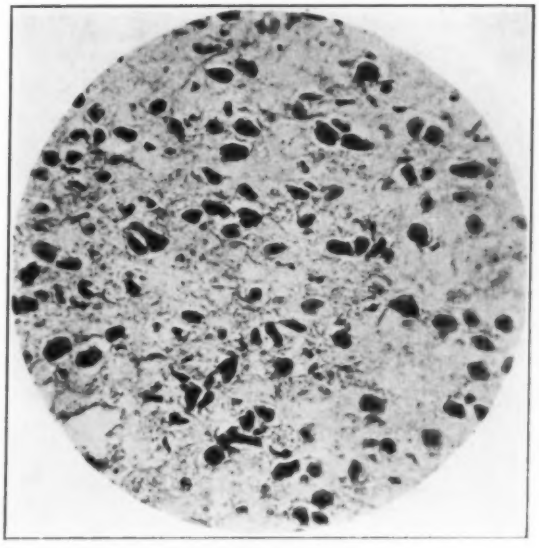


FIG. 7

Suprarenal gland: Zona reticularis in patient with renal rickets, aged 20.

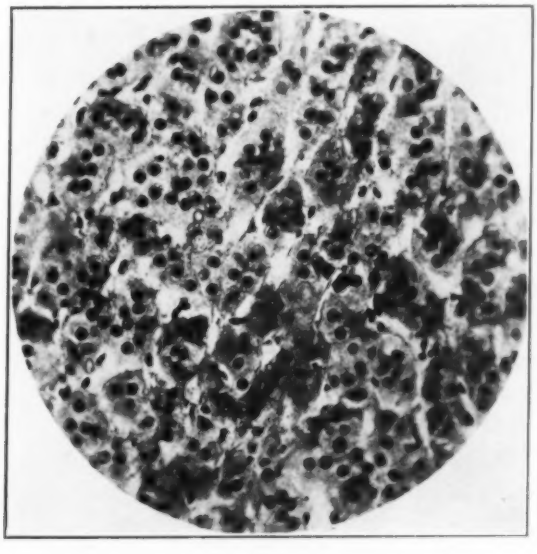


FIG. 8

Normal suprarenal: Zona reticularis. Same age and sex as Fig. 7.

increase in the connective tissue of the organ separating the cells from each other. The change affects mainly the zona reticularis, which is broader than normal, contains an excess of greenish pigment, and exhibits an altered staining reaction to Mallory's stain. Figure 7 shows the zona reticularis from a patient with renal rickets, a female aged 20. Figure 8 shows the normal zona reticularis for the same age and sex. I am indebted to Dr. E. R. A. Cooper for permission to photograph this slide. It is deduced from the histologic changes present in the suprarenal glands that there is alteration or deficiency in their secretion. The rest of the organs including the pituitary are normal.

Considering the pathology of the disease as a whole there is a chronic interstitial nephritis, a chronic inflammatory change in the suprarenal gland, and an inactive thyroid. It is suggested that the whole of this is dependent on and secondary to an ascending infection of the urinary tract of a long-continued and mild type, also that the inflammation has spread to the suprarenals from the kidney, and that the inactivity of the thyroid gland is due to diminished secretion of the suprarenal glands.

Passing from such theorizing to the results of observation, the cases in which renal function is definitely proved to be deficient present:—

1. A typical clinical picture.
2. A typical X-ray picture.
3. A typical post-mortem picture.

Briefly to recount these:

The clinical picture is one of the onset at puberty of deformities of the late rickets type, associated with a profound muscular asthenia; pallor; stunting without infantilism; a low specific gravity urine, pale in color and containing albumen; a notable absence of oedema and cardio-vascular change; a negative Wassermann; a negative Loewi, and a negative Goetsch test.

The X-ray picture is one of rarefaction and metaphyseal abnormality, hazy porosis, enlargement and lack of cortex, associated with some rachitic changes at the epiphyseal line.

The post-mortem picture is one of chronic interstitial nephritis associated with fibrosis of the suprarenal gland and an inactive thyroid gland.

The degree of renal involvement roughly parallels the degree of clinical and roentgenographic abnormality. It is to the association of the typical clinical picture, the typical X-ray picture, and deficient renal function that the term Renal Rickets has been applied.

While the kidney lesion may be responsible for certain of the findings such as albuminuria, nephritic signs and symptoms, and death from urae-

mia, the greater part of the picture is due to some cause other than deficient renal function, and I should like to suggest that this other cause may be deficiency of the suprarenal gland.

A number of patients presenting the renal rickets picture had had operations, usually some form of osteotomy, and it was constantly found that the results of these operations were bad, and in some cases disastrous. The legs, after being straight for a short time, rapidly gave way; deformity was again produced, and usually was of a much grosser type than had been present before operation. In several cases the history was obtained that the patient had never walked since the operation. Apart from this, operation, or more probably the administration of an anaesthetic, is attended with considerable immediate risk to life. The literature contains several instances in which operation precipitated an acute attack of uraemia from which the patient died within a few days. Assuming that osteotomy is not done where the roentgenogram shows signs of active rickets, the following would contra-indicate operation:—

(1) Definite or suspected renal inefficiency.
(2) A roentgen-ray appearance typical of renal rickets, in particular the fuzzy metaphyseal porosis.
(3) The presence of muscular asthenia.
(4) A urine of persistently low specific gravity, containing albumen.

Where any of these findings are present, operation is likely to be a disaster, and at the best only a poor result will be obtained. The tendency of the disease to begin about puberty and the tendency of operation to precipitate its onset in a predisposed person suggest that if there is any evidence, clinical or roentgenographic, of the renal rickets type, it is advisable to defer operation for some years, until the time of puberty is past and the endocrine system not so likely to break down, and until the patient has been under observation for a considerable period of time. It is recommended that during this probation period clinical examination, measurements of deformities, roentgenographic examination, and renal efficiency tests should be performed at intervals. The clinical appearance of this class of case is typical, and the well-developed ones are easily picked out. It is the milder cases, where there is only a suggestion of the renal rickets picture, that are likely to be overlooked, and it is for these that a plea is made that they should be given very great consideration before osteotomy is advised. It is suggested that before an adolescent with bone deformity comes to operation renal function tests should be carried out.

The treatment which was given to the cases of renal rickets and to those of similar nature included cod-liver oil; calcium lactate in small doses,

not so much in the hope of improving any deficiency of calcium, as for its beneficial effect in such dosage in the albuminuria of adolescence; and thyroid extract, where there was hypothyroidism. In addition to drug treatment the patients received courses of massage and remedial exercises. It was found that under such a régime the disease appeared to be arrested. The increase of the deformity was stopped and the patient's general condition improved, with ability to walk much better, and the muscular asthenia was strikingly diminished. Some cases showed improvement in the condition of the bones as seen in the roentgenogram, and in some there was a possible diminution in the degree of deformity. This latter, however, was not usual, and was perhaps not to be expected. Where definite renal deficiency was present, the treatment did not seem to bring about any improvement in the renal condition, but, with the exception of one case, none of the patients has deteriorated to any marked degree as regards the renal function. They were advised to take a good diet and to persevere with their walking, to rub the legs for themselves, and to try to get about as much as possible. In the early stages of treatment, when the deformities were increasing or when the curvature was gross or roentgenographic appearance suggested the possibility of fracture, a mechanical support was supplied, but this was not usual.

The tendency of patients with chronic interstitial nephritis with stunting and bone deformity has in general been found to be progressively down-hill, and usually between twenty and thirty years of age they come to a fatal end from uraemia. It is too early as yet to say whether the arrest of the disease, and improvement produced by this line of treatment, will be permanent or not.

SUMMARY

Renal rickets is a condition in which bone deformity of the late rickets type is associated with renal disease. An investigation of this type of case has shown that 33% have definite renal inefficiency, and 54% reveal some renal defect. Sufficient evidence has been found to warrant the suggestion that the disease may be due to a fibrosis of the suprarenal gland.

REFERENCES

1. Naish, A. E.: British Journal of Children's Diseases, 1912, p. 33.
2. Barber, Hugh: Quarterly Journal of Medicine, Vol. 14, No. 55, p. 205, April, 1921.

DISCUSSION

Mr. H. A. T. Fairbank congratulated the Association on hearing such an interesting paper. He would like to ask Dr. Ashcroft whether he had met with any cases with

glycosuria. He (the speaker) had met with two cases of renal dwarfs with glycosuria. The first was regarded as of pancreatic origin, both the pancreas and kidneys being affected by the same toxic agent. In the second he had had complete examinations made, and these had proved that the glycosuria was renal and not pancreatic in origin. This second patient, a girl of twelve, showed rickety changes in the bones, and skiagrams of these he was able to show. The first patient was seen at the age of six, with long, thin, wasted limbs and marked genu valgum. The deformity was corrected by splints and screw pressure. Two years later the patient was seen again: no growth whatsoever had taken place. The child showed multiple deformities resulting from juxta-epiphyseal fractures, which in the case of the wrists were obviously mobile and ununited. In a few months the child died. These cases differed markedly from ordinary rickets in this tendency to bending and fractures in the juxta-epiphyseal region. Could any explanation of this be offered? He understood Dr. Ashcroft to say that renal insufficiency in these cases was accompanied by rickety changes in the bones. He had met with renal dwarfs with definite renal insufficiency without rickety changes in the bones, and showed skiagrams and a photograph of such a patient, a boy of six, in whom the urea concentration test showed the maximum urea excretion to be 1.9% instead of the normal 2.5 to 4%. There were unquestionably various types of bone affections secondary to renal disease. He had seen deformities associated with renal disease in older children without dwarfism.

ARTIFICIAL LIMBS: THEIR RELATION TO THE DIFFERENT TYPES OF AMPUTATION STUMPS

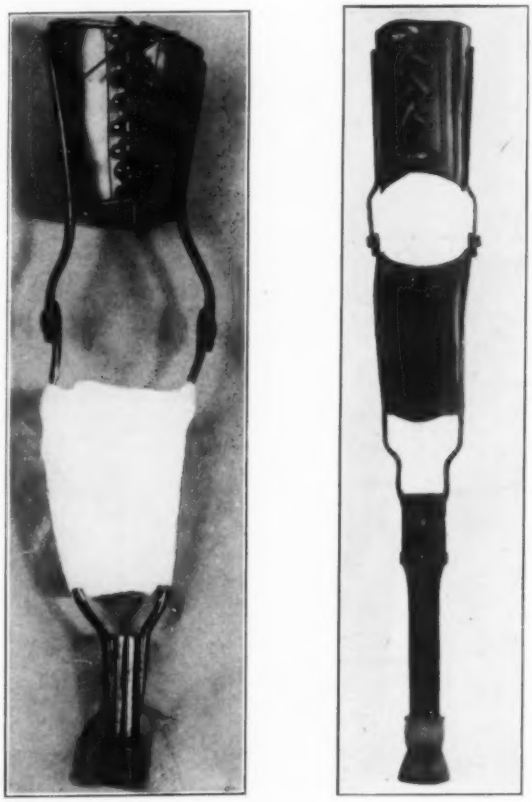
BY A. B. LEMESURIER, M.B., TORONTO

It might appear on first thought that the subject of artificial limbs had little to do with the surgeon. This is true, too, to a certain extent, in that the actual making of the limbs is entirely in the hands of the limb-fitters. But it must be remembered that the efficiency of any amputation stump is essentially the efficiency of that stump *when fitted with an artificial limb*, and every amputation should be done with the idea of leaving the stump that is most suitable for the particular type of limb that is eventually to be worn. Some knowledge, then, of the different kinds of artificial limbs is essential to any surgeon doing amputations.

A further reason for knowing something about the subject is that the patient needs advice in the purchase of his limb. He has otherwise little means of discriminating between the claims of the rival manufacturers who have no interest other than a commercial one in making a sale. It should be part of the duty of the surgeon to give disinterested advice as to the proper time for fitting, the most suitable type of limb to buy, and the best limb-fitting firm to employ; and, as so few patients have had sufficient experience to know how a limb should fit and work, the surgeon should be in a position to decide whether or not the limb supplied is satisfactory and to make any suggestions necessary for its improvement. If this supervision were carried out thoroughly it would soon eliminate the firms turning out poor work, of which there are, unfortunately, still some in existence, and would unquestionably improve the standard of limb-fitting throughout the country.

The opinions expressed in this paper may differ in some respects from those generally held, but they are based on an experience of five years in charge of the limb-fitting clinic of the Department of Soldiers' Civil Re-Establishment of Canada, the Department that not only looks after the surgical treatment of war amputation cases, but also manufactures in its own factories all artificial limbs issued, thus providing an exceptional opportunity of observing all phases of the subject.

No description of artificial limbs would be complete without including those appliances designed to hasten the shrinking of the stump to its final



A. *B.*

FIG. 1

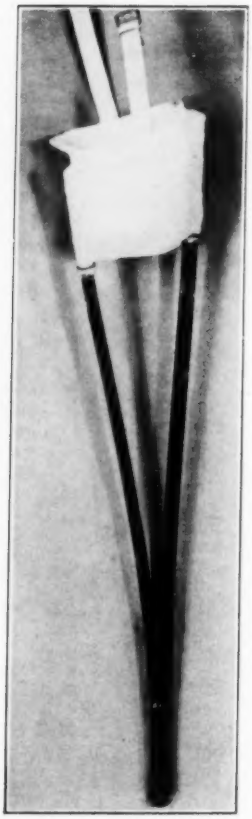
PEG LEGS FOR BELOW-KNEE AMPUTATIONS

A. With plaster bucket, taking weight on the expanding upper end of the tibia.

B. With leather bucket, made on altered model of stump, with lacing behind to accommodate for shrinking.

Both types have stop-joints at knee and above-knee corsets.

size. This shrinking is due to the subsidence of the oedema always present after amputation and to the atrophy of the muscles which have largely lost their insertion. That due to the first factor takes place fairly rapidly,



C. *D.*

FIG. 1

PEG LEGS FOR ABOVE-KNEE AMPUTATIONS

C. With plaster bucket moulded to take weight on the ischium. The rest of the appliance is made from a strong crutch.

D. With padded weight-bearing ring like a Thomas splint, and with leather lacer that can be taken in as stump shrinks.

Both types require a harness over the shoulder and are better without any joint at the knee.

but the muscle atrophy may continue to progress for a year or more. The shrinking may be hastened by firm uniform bandaging and massage, both of which may be commenced cautiously shortly after the wound has healed. In the upper extremity this is all that is necessary, but in the lower extremity, where the shrinking is greater in extent, it may be promoted more rapidly by means of a temporary shrinking appliance on which the patient walks. This consists of a bucket to fit the stump, made either of plaster-of-Paris, which can be renewed, or of leather which can be laced more tightly to fit the stump as it shrinks. The rest of the appliance consists of a simple frame-work ending in a peg armed with a large rubber crutch-tip, the whole being made as lightly and inexpensively as possible. (Fig. 1.) As a rule these peg-legs may be fitted within six weeks of the healing of the wound in above-knee amputations, and about a month later in end-bearing amputations or in those below the knee, without fear of opening the wound or of harming the stump in any way. They not only promote shrinking and accustom the stump to pressure, but their use strengthens the muscles controlling the stump and teaches the wearer to maintain his balance. A firm bandage should always be applied in the intervals when the peg is not worn.

As shrinking of the stump takes place, it is accommodated for by the wearing of additional stump socks and the occasional changing of the plaster bucket or the lacing up of the leather one. After a length of time varying from three or four months to a year from the amputation, the shrinking will cease. All oedema will have disappeared and the muscles will to a large extent have lost their flabbiness. The stump is now ready to be fitted with a completed artificial limb.

LOWER EXTREMITY

For ordinary walking the artificial leg makes a fairly good substitute for the real one. The movements required are few and comparatively simple, and are copied fairly efficiently and realistically by the mechanism of the modern artificial limb. This mechanism, however, is made to reproduce only the movements of walking, and when an attempt is made to perform any of the more complicated actions, such as running or jumping, the artificial leg, like all other prosthetic appliances, lacks the versatility of the normal limb and is almost useless. While the wearer of an artificial leg can walk and can often do heavy manual labor, he is greatly handicapped in following the usual recreations of the two-legged man and is prevented from playing most games.

Besides reproducing mechanically the movements of walking the artificial leg must bear the body weight comfortably and often for long periods at a time. This bearing of the weight is achieved in one of two

A. *B.*

FIG. 2

SYME'S STUMPS

A. Syme's stump four months after operation, showing redundant skin still present at corners of incision and heel flap excessively thick.

B. Syme's stump seven years after operation, showing thinning that occurs in tissues covering the end.

ways, either directly on the end of the stump—"end-bearing"—or by what is called "lateral-bearing," on a convenient bony prominence some distance above the end of the stump.

There is no comparison between the efficiency of the two methods,

end-bearing being much the more satisfactory in every way. The end-bearing stump will carry the whole body weight on its broad end for long periods without discomfort or chafing, and the fact that the weight is taken on the end of the stump seems to give the patient a better idea of the whereabouts of the ground and consequently improves his balance

FIG. 3

ARTIFICIAL LEG FOR SYME'S AMPUTATION
Type with steels up either side.

and gait. Moreover, the end-bearing stump is much easier to fit with a bucket, which is usually made by moulding heavy leather over a slightly altered plaster model made from the stump itself. However, to obtain a satisfactory end-bearing stump certain essentials are necessary. The end of the bone must be broad and smooth, the scar must be away from the bearing surface, the soft tissues over the end must be well nourished

and preferably accustomed to pressure, and there must be no points of tenderness. We would attempt to make all lower-limb stumps end-bearing, but unfortunately the necessary conditions are present at only certain levels, and, as the length of stump is such an important factor in controlling the limb, it is seldom that it should be sacrificed for the sake of improved weight-bearing. The regions where end-bearing stumps can be obtained are: the region of the lower end of the femur, just above the ankle, and occasionally through the head of the tibia.

The Syme's amputation leaves, without question, the best of all the stumps with which we have to deal (Fig. 2). The bearing of the broad end of the bone, covered by tissue accustomed to pressure, against the end of the bucket is so satisfactory that it permits the patient to be on his feet all day without discomfort. Chafing is extremely rare, and although there are a great many ex-soldiers with Syme's amputation, we practically never see them at the amputation clinics unless they break their artificial legs.

In making a leg for a Syme's amputation (Fig. 3) a plaster model of the stump is obtained, and altered slightly by reducing its circumference and building it up over the prominent bony points, such as the crest of the tibia, where pressure is to be avoided. On this model the bucket is moulded of heavy leather, extending upward to just below the knee and having an opening down the whole length of the front or side to facilitate insertion. When this opening is laced up, the grip above the bulbous end of the stump is sufficient to hold the leg on and does away with the need of any retaining harness above the knee. The end of the bucket is somewhat rounded to conform to the rounded end of the stump, and in most cases the comfort of weight-bearing may be increased by the judicious use of thin, carefully bevelled felt pads.

At the bottom of the bucket is the ankle-joint, fixed to it by means of a steel cup and steel uprights running well up the bucket. There is a considerable strain in walking, from the ankle up, so that these steel parts have to be comparatively heavy. It makes very little difference to the efficiency of the leg whether these uprights run up the front and back or up the two sides of the bucket. In a patient who is thin, with a sharp tibial crest, it is perhaps more comfortable to have these steels on either side, with the padded tongue in front, while in other cases the front and back arrangement, with the opening on the inner side, makes the bulk about the ankle less noticeable.

In most Syme's amputations, when the soft tissues have shrunk to their final size, there is a clearance of nearly two inches between the end

of the stump and the ground—ample room for a mechanically satisfactory ankle-joint, which is controlled by rubber buffers in front and behind. There is no special feature about the foot, except that, to lessen the strain when weight is taken on the ball, the length of the lever concerned may be shortened by placing the toe-joint a little farther back than usual.

The gait, with the limb described, is excellent. The ankle movement is very realistic and, except for a certain stiffness in the foot action and an increased bulk about the ankle, it is difficult to detect the loss of the foot, and most possessors of Syme's stumps are not only able to resume their former occupations, but are also able to participate to a certain extent in the recreations of the normal individual.

There has been no marked advance in the actual operation since the method described in the text-books in which the os calcis is shelled out from behind forward. The heel incision should reach, on the inner side, to within half an inch of the tip of the internal malleolus, and should be inclined slightly backward under the heel. The bones should be sawed through a quarter of an inch above the ankle-joint, where they are broad enough to bear weight, but not unduly broad. The plane of the saw-cut should be at right angles to the long axis of the whole leg. If it is made at right angles to the long axis of the lower third of the tibia, which is often inclined a good deal inward, the outer edge of the bearing surface will project somewhat and the patient loses the ability to walk in comfort on his bare stump, although, by adjusting the padding in the bucket to the obliquity, he can walk perfectly well on his artificial limb. To avoid the posterior tibial artery and its external plantar branch, which are placed deeply and from which the calcanean branches supplying the heel flap arise, the incision on the inner side should not lie behind the internal malleolus, and the dissection of the os calcis must be carried out next to the bone. It is therefore inevitable that, at the end of the operation, there will be two folds of redundant skin, one at either end of the incision, and the heel flap will seem excessively thick and insecure. Fortunately the former defect disappears during the stage of shrinking, and the heel cushion, like any other soft-tissue flap covering an end-bearing stump, continues to shrink for three or four years with the weight-bearing; therefore the thicker it is at operation the better. There is a strong tendency for the great lump of tissue forming the apex of the flap to be displaced backward or to the inner side during the week or two following the operation, and, as the efficiency of the stump depends so largely on this cushion healing in the proper position, great care should be taken to prevent its displacement. At operation the flap should be so fashioned that it does

not lie too loosely over the end of the bone, and its security is increased by inserting, in addition to the skin sutures, a row of buried sutures fixing it to the periosteum and deep tissues in front of the tibia. When the operation is completed bandaging over a bulky dressing is not sufficiently reliable, and therefore a small gauze dressing should be applied to the wound, and over it four long adhesive straps, two running in each of the antero-posterior and lateral planes. The drainage tube, which should be inserted at one angle of the wound, projects through this first layer and additional dressings are applied on the outside to absorb discharges. The outer dressings may be changed as often as desired, and the stump inspected, but the strapping should remain in place until the sutures are removed. Finally, as the efficiency of the Syme's stump, in common with other end-bearing stumps, depends largely on obtaining primary healing and a linear scar, the operation should not be done in infections of the ankle-joint and, if for open injury of the foot, should be done either early or after infection has subsided.

In comparing the Syme's amputation with any amputations through the tarsus, the advantage is all with the former. The great majority of Syme's stumps can tolerate the whole of the weight on their end for the whole day. They have only two drawbacks, and they are slight ones: one is that the artificial limb is bulky about the ankle and necessitates the wearing of either a low shoe or an ankle boot that is specially made or altered to fit, and the other is the weight of the appliance, about three pounds on the average.

Occasionally one sees an amputation done at or about the line of the tarso-metatarsal joint (Hey, Lisfranc, etc.), in which the scar is linear and on the dorsum away from pressure, in which there is active dorsiflexion to the normal range and in which there is no lateral deviation or instability of the stump of the foot. Such a stump, when fitted with a boot having a stiff steel sole-plate running as far forward as the ball, and its toe filled with cork, may enable the wearer to get about quite satisfactorily, and has the advantage of appearance over the Syme's. But most stumps amputated through the tarso-metatarsal line, and practically all amputated through the tarsus behind are far from satisfactory. They nearly all develop an equinus deformity which is progressive (Fig. 4) and a lateral distortion of the tarsal bones which gives an uneven bearing surface. Moreover, the scar, although originally on the dorsum, may be pulled into the sole, where it is subjected to excessive pressure. We have had to re-amputate nearly all of our army cases of this nature at the Syme's level, with invariable satisfaction to the patient, and have come to the

conclusion that, while in a few cases where, as in the case of a woman, appearance is important, where the scar can be placed well on the dorsum and where there is every likelihood of primary healing, an amputation through the

FIG. 4

Amputation through the mid-tarsal joint (Chopart), showing the usual equinus deformity.

tarso-metatarsal region is justified; in the great majority of cases where the metatarsal tread cannot be preserved the Syme's amputation is the operation of choice.

The other region in which end-bearing stumps may be obtained is the region of the knee. Here three operations are practised—the Stokes-Gritti amputation, the transcondylar amputation, and the disarticulation

through the joint, all of them done by means of a long anterior flap, leaving the scar behind and away from pressure. While all these are fairly satisfactory, we have found the stump left by the Stokes-Gritti operation (Fig. 5) to be the best, both from the point of view of its ability to bear weight and the ease with which it can be fitted with an artificial leg of

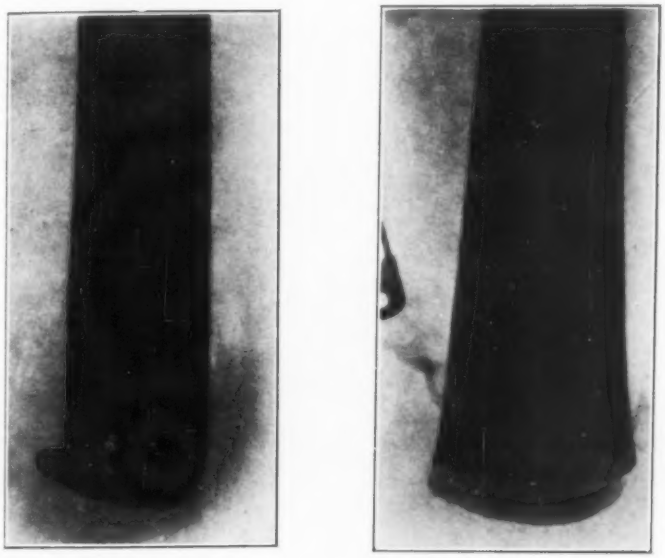
FIG. 5

STOKES-GRITTI STUMP

The scar is behind and above the end and the patella is firmly fixed in the horizontal position. The uneven appearance of the end of the stump is due to a redundancy of the soft tissues and not to any obliquity of the patella.

good appearance; the transcondylar amputation next, and the disarticulation the least satisfactory. The last-mentioned operation leaves a stump that is bulbous at the end, that has an irregular bearing surface, and that is too long to be fitted with an ordinary knee-joint. As a result the joint must be obtained by two metal hinges, one on either side, an arrangement that further increases the bulk about the knee. Moreover, the operation requires a flap that extends a considerable distance below the joint line and is therefore limited in its application.

In the Stokes-Gritti stump, the entire weight is taken on the front of the patella, which is fixed in a horizontal position to the cut end of the femur, and presents a smooth rounded surface covered by soft tissues accustomed to pressure. The success of the operation depends in a large measure on obtaining a permanent union in the proper position, preferably by bone, between the femur and the patella (Fig. 6), and great care should be taken at operation to insure that this position is maintained during the



A. *B.*

FIG. 6

Skiagrams of Stokes-Gritti Stump, showing relative position of patella and femur.

healing against the constant tendency of the attached quadriceps to tilt the patella forward. A slight tilting need not interfere greatly with weight-bearing if the end of the bucket is accommodated to the obliquity, but if this tilting becomes marked it should be corrected by a later operation.

The amputation is done by means of a long anterior flap, the lowest point of the incision passing through the patellar tendon. No attempt is made to dissect out the synovial membrane, and it never causes any trouble. The cartilage is removed from the back of the patella down to undoubted bone, and the femur is divided sufficiently high so that when

the patella is placed on the end the quadriceps will not be under undue tension. The patellar tendon is sutured in place, and the patella is further

FIG. 7

ARTIFICIAL LEG FOR STOKES-GRITTI AMPUTATION

The bucket is of leather, fitting at its lower end into an ordinary wooden knee-block. The knee-joint is obtained by a pin through this knee-block, is placed at the proper knee level, and is not unduly bulky.

fixed to the cut end of the femur by at least two kangaroo-tendon sutures passed through drill-holes in both bones, and on account of its great tendency to tilt forward it has been found to be a good plan at the con-

clusion of the operation to pass a long thin nail through a small cut in the skin, through the patella and into the femur. The nail is left projecting at least an inch at its head end so that it will not be buried in the subsequent swelling of the soft tissues. It is removed after three weeks and the small scar interferes not at all with weight-bearing.

The bucket for this type of stump is made of heavy leather moulded over a plaster cast of the stump (Fig. 7). It is fixed to an ordinary knee-block, and the knee-joint, the leg below the knee, and the retaining harness are exactly the same as in the ordinary above-knee leg.

All these three types of end-bearing stumps about the knee lack the direct control of the joint, and therefore give the characteristic limp seen with any above-knee amputation. They all carry the weight comfortably, chafing is practically unknown, and they can, if necessary, be walked on for the whole day without undue pain. In this respect, i.e., from the point of view of weight-bearing alone, they are much superior to a lateral-bearing stump no matter at what level, particularly for a man who has to work on his feet all day.

So satisfactory is the method of carrying weight by end-bearing that attempts are constantly being made to obtain it at levels other than those described. Occasionally it is possible to obtain a good end-bearing stump from an amputation done two or three inches below the knee, in which one flap is long enough to bring the scar away from the weight-bearing surface. Such an amputation combines the advantages of end-bearing with a certain amount of direct control of the knee, and should be done under the rare conditions that call for a high division of the tibia and yet leave enough soft tissue to make one long flap.

Attempts to obtain good end-bearing at levels where the bone is narrow are nearly always failures, even though the covering of the end of the stump at operation is well nourished and the scar is linear and away from pressure. A certain amount of tolerance to pressure may be gradually worked up, and in some cases complete end-bearing may be possible for a year or more. Gradually, however, the pressure of the narrow end of the bone so thins out the soft tissues that eventually the covering of the end comes to consist of little more than skin. End-bearing on such a stump is less satisfactory than lateral bearing, and we have therefore given up attempting to obtain it except in the stumps amputated at the levels described and specially prepared for it.

In our earlier experience we attempted to combine the methods of lateral and end-bearing, particularly in amputations through the thigh where the scar was behind and the end of the bone covered by a well-

nourished pad of soft tissues. An ordinary lateral-bearing bucket was made, and in it was suspended a "partial end-bearing" platform, adjusted with the intention of taking half the weight on the end of the stump. We had the greatest difficulty in getting the men to wear this device. Their complaint was always the same, that for a time the arrangement was comfortable and satisfactory, but that towards the close of the day the end of the stump seemed to be taking all the weight, and became sore. Apparently as they walked about, the stump worked farther and farther into the bucket, until finally the weight, instead of being divided evenly between the ischium and the end of the stump, came to be taken entirely on the end. No adjustment of the partial end-bearing platform could be obtained that was satisfactory, and we have now practically abandoned the method.

The great majority of lower extremity stumps are incapable of bearing the weight on the end and must therefore be fitted with lateral-bearing buckets. With these the body weight, instead of being carried on the broad horizontal end, is carried essentially on some bony surface that is neither very extensive nor very prominent, and it is therefore not to be expected that the bearing will be anything like as satisfactory. In the lateral-bearing legs, in order to make the most of what bearing surface presents itself, expert fitting is essential: much more so than in end-bearing ones, and in order to carry the weight on selected areas that will tolerate it and to avoid pressure on points that will not, the bucket should be of some rigid material that will maintain its exact shape indefinitely. The trouble here, when a yielding material like leather is used, is that in time the shape of the bucket becomes altered, and the weight, instead of being carried on selected areas, comes to be taken evenly all around the rim, and in places will not be tolerated. In our experience the material that best satisfies all requirements is well-seasoned willow. It is very light, easily worked, and when covered with a layer of rawhide, is strong and maintains its form permanently. Moreover, it readily permits any subsequent slight alteration that may be necessary for the comfort of the patient.

The most difficult stumps of all to fit with a bucket are those below the knee. Here the weight is taken on the expanding front and sides of the upper end of the tibia, particularly the inner side. Often the bone expands very little and the sides of the stump are almost parallel. In these cases it is surprising how the weight is carried at all. The bucket (Fig. 8) is best made of willow very carefully fashioned to take advantage of every surface that will tolerate weight, but at the same time to avoid pressure on the tubercle and sharp crest of the tibia and on the head of

the fibula and peroneal nerve. It extends in front to just below the patella, but is cut lower behind to avoid the hamstring tendons in flexion of the knee. The ankle-joint works in the one plane with a small range of movement checked at both extremes by rubber buffers. The foot should have a flexible felt toe or, if all of wood, a joint just beyond the ball.

FIG. 8

ARTIFICIAL LEG FOR BELOW-KNEE AMPUTATION

No matter how long the stump is, any below-knee amputation short of a Syme's should have a thigh corset fastened to the bucket on either side by a steel joint, fitted with a stop at 180°. This not only helps to hold the artificial leg in place, but also acts as a brace to protect the ligaments of the knee from injury. At one time we attempted to dispense with these above-knee joints and corsets in long stumps ending just above the ankle,

but most of the cases with these short artificial legs showed definite signs of ligamentous strain and now we use the corset in all below-knee amputations above the Syme's level. In addition to the corset the leg requires a retaining harness over the shoulders, and as a rule the gait is improved by a strap from the shoulder-harness passing over the front of the knee to the bucket, to aid extension.

There are two faults commonly found in this type of artificial leg that can be attributed to an error in the making of the leg itself. One is a bucket that does not fit properly. This means, as a rule, that too much weight is carried around its rim or on some exposed bony prominence like the head of the fibula or the crest of the tibia, or that not enough weight is carried on the antero-internal aspect of the internal tuberosity and on the sloping surface of the bone below it, where the greater part of the weight should be borne. This fault shows itself by the appearance of redness of the skin after the leg has been worn for an hour or two. The other common fault is an improper alignment of the above-knee corset on the bucket. Every below-knee stump presents the appearance of having a considerable degree of knock-knee. This is due, not to any distortion of the knee-joint, but to the normal inclination of the upper part of the tibia, and becomes more obvious as the calf muscles shrink. Unless this angle is allowed for when the side steels are fixed to the bucket, the bucket will be held considerably straighter than the stump, and there will be excessive pressure on two points—on the inner side near the top of the stump and on the outer side near its end. The test for the line-up is to make the patient stand with his stump in a comfortable position in the bucket and with the above-knee corset bent back out of the way. When the corset is brought up into contact with the thigh, it can readily be seen whether or not the alignment is correct.

On the whole it may be said that these below-knee stumps are from the first the most troublesome with which we have to deal. The oedema persists in them longest after operation. Weight-bearing in any kind of temporary appliance must be delayed longer. Flexion deformity at the knee is often seen if the after-treatment has been neglected, but as a rule is a temporary thing and can be corrected during the wearing of the peg. When the stump has attained its final form it is more difficult to fit with a leg than any other type of stump. Even with the best of stumps and with the best-fitting limb the ability to bear weight is not good, and it is very rare to find a man who can do heavy manual work day after day, and not common to find one who can walk as far as two or three miles without pain. Chafing of the stump is the rule if it is walked on too much or not carefully

looked after. Unless the stump is well covered it will be found that the comfort is increased by the wearing of two stump-socks, and, if shrinking is complete, allowance for these should be made when the bucket is being fitted. Infections of the skin and persistent eczema are fairly common and necessitate leaving the leg off for the time, at least, and we frequently

FIG. 9

GOOD BELOW-KNEE STUMP, SHOWING EXPANDING UPPER END OF TIBIA, ON WHICH WEIGHT IS TAKEN.

see trouble from pulling on the scar or from defective circulation. But in spite of all these disadvantages, the below-knee stump has one great advantage that in most cases more than makes up for its defects, and that is that with it the wearer has direct control of the knee-joint of his artificial limb, and although he cannot stand as long or walk as far, his gait is very much better than that of any above-knee amputation case.

The best length for a below-knee stump is six or seven inches (Fig. 9). Stumps longer than this nearly always have a defective circulation and

are cold and cyanosed and often oedematous or ulcerated. With stumps ending near the ankle the proper insertion of an ankle-joint is interfered with, and the additional length seems to add nothing to the control over the knee. If Syme's amputation, therefore, is out of the question, the bones should be divided about the middle of the leg. Above this the shorter the stump the less satisfactory it is. As the level of amputation approaches the knee-joint, the stump becomes so short that it constantly slips out of the bucket on sitting and it loses its ability to control the joint, which is the only advantage the below-knee stump has. If, then, it is impossible to leave more than three inches of tibia, an amputation above the knee, leaving an end-bearing stump, is preferable. The same is true of a good many stumps longer than three inches, but as it is impossible to predict at the primary operation how useful the stump will be, any length of stump greater than three inches should be left. If, on the wearing of a well-made leg, a short below-knee stump constantly gives trouble, we should without too much delay convert it into an above-knee, end-bearing stump, particularly if the patient by education and training is fitted for nothing but manual labor.

In the actual performance of the amputation it seems to make very little difference to the ultimate usefulness of the stump whether the flaps are antero-posterior or lateral, equal or unequal. The main thing is to get a scar that is not adherent to the bone, and this can be obtained by leaving the flaps sufficiently long to allow for subsequent retraction, by interposing a thick layer of soft tissue between the bone and the skin, and by getting healing by first intention. So unsatisfactory is the broad adherent scar resulting from the healing by granulation of an infected wound that its excision is often justified, even at the expense of shortening the stump. The sharp front angle of the tibia should always be rounded off and care should be taken that the scar does not lie over it. Thus, if the amputation is done by lateral flaps, the incision behind may extend as high as we wish, but in front should end below the level of bone section, so that when the wound is sutured it will be on the end rather than the front of the stump. The fibula should always be divided at a higher level than the tibia, particularly in short stumps, where it is apt to project laterally and to interfere with the proper fitting of the bucket. All sensory nerves should be cut as short as possible and allowed to retract well away from the scar. And finally, after operation, the knee should be held in the extended position by some kind of splint until the wound is healed and active movement begun.

The commonest of all amputation stumps are those through the thigh

above the level at which end-bearing is possible. With these the weight has to be carried essentially on the ischial tuberosity, and the bucket is made with a seat-like shelf which comes in contact with this and with the

FIG. 10

ARTIFICIAL LEG FOR ABOVE-KNEE AMPUTATION

The bucket is carefully fitted to take weight on the ischial tuberosity.

buttock in the neighborhood. The rest of the bucket merely holds the ischium on this shelf, and grips the stump to provide the necessary leverage. It is best made of willow, and is fashioned to avoid pressure on the trochanter, on the sharp ramus of the ischium, and on the tendon of the adductor longus. The rest of the leg (Fig. 10) is usually made of willow,

but recently several limb-fitting firms have been using duralumin, with a saving in weight of about a pound. As the average well-made willow leg for above-knee amputations weighs only about five or five and a half pounds, there is no great point in this saving if the stump is of decent length, but with a short stump, any decrease in weight is an advantage. At the lower end of the bucket is the knee-joint, which is not controlled directly, but depends for its extension in walking on the pendulum-like swing of the leg below it, aided by some weak spring in the mechanism and by a strap from the shoulder-harness over the front of the knee. The ankle and foot are the same as in the below-knee leg, except that the rubber buffers in the ankle are so arranged as to throw the foot into slight equinus. This equinus, together with the fact that the knee-joint is placed slightly behind the line of weight-bearing, causes the knee to lock in complete extension when weight is thrown on the leg rather than to flex and allow the wearer to fall. In length the whole leg should be about half an inch shorter than the normal one—a difference that assists the artificial foot to clear the ground without making the patient raise himself on the opposite toe or tilt his pelvis excessively. The whole limb is held to the stump by a harness over both shoulders.

The ischium provides a better weight-bearing surface than the head of the tibia, and in consequence these above-knee amputation patients can stand and walk longer on their legs than can the below-knee ones, and the buckets are easier to fit comfortably. Their gait, however, is not nearly so good, particularly when the stump is too short by itself to thrust the limb forward and this movement must be obtained by a pendulum-like swing from the hip. The placing of the foot at each step is an effort and must be watched carefully, and the slightest misstep or irregularity in the footing may cause the knee to break forward and the patient to fall. Practically all cases of above-knee amputation carry a cane in the opposite hand.

As in the below-knee amputations a scar in front of the end of the stump is a disadvantage, as it strikes the front of the bucket every time the stump swings the limb forward. The amputation should therefore be done, if possible, by a long anterior and short posterior flap, or failing that, by flaps of equal length. A scar adherent to the end of the bone may cause trouble if it is extensive, but is not nearly so troublesome as a similar scar in a below-knee amputation, as weight-bearing on the tuber ischii does not cause the same pull on the skin. Puckering or crevice formation about the scar is very common in thigh stumps and often the cause of skin irritation, particularly in the warm weather. It is very difficult to prevent entirely on account of the great shrinking that occurs and the marked and uneven

retraction of the muscles. As a rule the mistake is made of cutting the flaps too square. If they are made rounded or tapering, and carefully trimmed to fit accurately when sutured, this puckering will be reduced to a minimum.

The greater the length of stump that can be left the better (Fig. 11). With a long stump not only is the forward thrust of the leg improved, but the stability of the artificial knee is increased by the ability to thrust back-

FIG. 11

GOOD ABOVE-KNEE STUMP

The length is ample for leverage. The soft tissues lie over the end of the bone loosely and without puckering.

ward when the foot is on the ground and thus to hold the knee in extension when weight is borne. Above the middle of the femur the control of the artificial limb diminishes markedly, and if the stump projects only two or three inches beyond the perineum, it keeps slipping out of the bucket on sitting, and its control of the artificial leg is poor. Both these faults may be remedied to a certain extent by the addition of a pelvic belt (Fig. 12), a belt half of spring steel, completed by leather, that encircles the body between the iliac crest and the great trochanter. It is fixed to the bucket

by a metal bar, fitted at the hip level with a joint working in the antero-posterior plane only. In England particularly the limb-makers prefer to fit a pelvic belt to every above-knee amputation, but the majority of our

FIG. 12

SHORT ABOVE-KNEE AMPUTATION, WITH ARTIFICIAL LEG FITTED WITH PELVIC BELT.

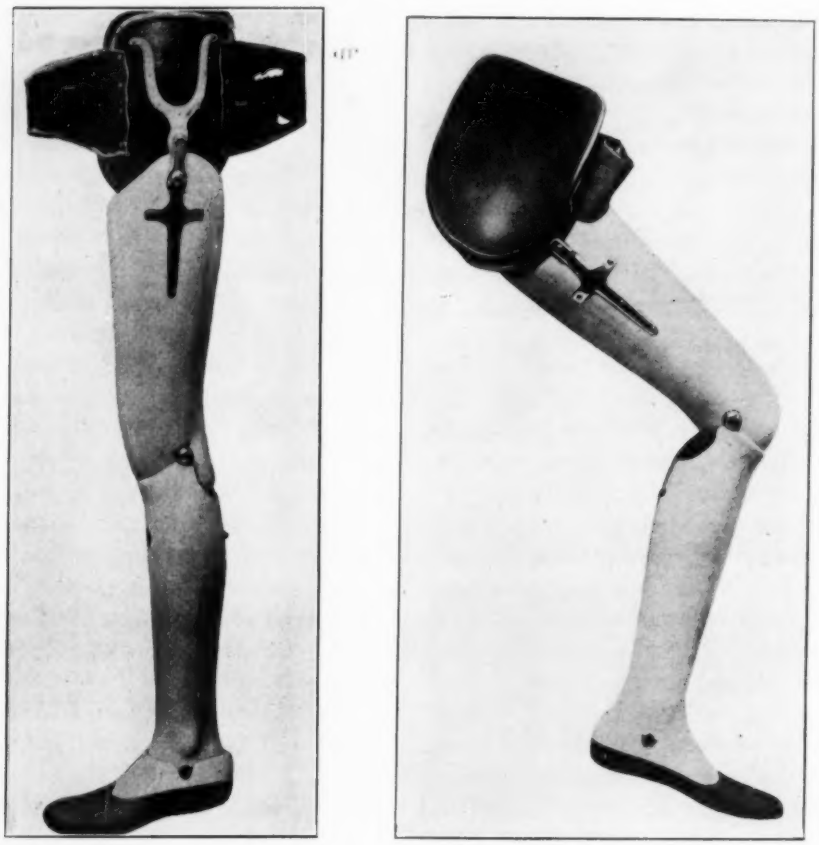
army patients with long stumps who had their first leg supplied in England with the belt have much preferred the freedom obtained in their second leg made here without it. For short stumps, however, the belt is of great assistance, and we have found the joint that works in the one plane only to be more satisfactory than any type of universal joint.

Another great disadvantage of short thigh stumps is the frequent occurrence with them of contractures about the hip-joint, resulting usually in flexion or abduction deformities. These can be prevented to some extent by careful post-operative treatment—keeping the stump straight during the healing of the wound and starting active movement in every direction as soon as possible. Once the deformity has developed in a short stump it is almost impossible to correct completely. Fitting an ordinary leg on a stump in flexion—the usual deformity—causes a tilting of the pelvis and a lumbar lordosis, with pain in the back on walking. It becomes necessary, therefore, to adapt the artificial limb to the deformed stump, and fortunately, if the deformity is not great, this is readily accomplished. The bucket is made to fit the stump and allowed to lie in the position of flexion or abduction that the stump assumes. Its lower end is then sawed parallel to the ground and the rest of the leg fixed to it perpendicularly, so that the foot comes under the point of weight-bearing. The bucket and the rest of the leg are joined by an angle corresponding to the degree of flexion or abduction deformity, but as such a deformed stump is nearly always short, this angle is not obvious and is concealed by the clothing.

Any thigh stump on which an artificial leg can be held by a belt and harness should be fitted with a leg of the type described above. If the projection of the femur below the perineum is less than two inches, it becomes impossible to keep such a leg in place, and we must resort to the "tilting-table" type of leg. With this pattern of leg, any projecting stump at all is a disadvantage and therefore, at operation, if not more than two inches of femur can be left below the perineum, it is better to amputate through the femoral neck or to disarticulate at the hip.

The tilting table is a basin-shaped bucket, usually made of leather, which encloses the pelvis and carries the weight on the ischium and buttock of the amputated side (Fig. 13). The rest of the leg is much the same as the ordinary above-knee leg, and is fixed to the tilting table by rather complicated joints which can be locked in complete extension for walking, but which will permit the thigh to be flexed out of the way and allow the patient to sit on the bottom of his tilting-table bucket. With this type of leg the weight-bearing is excellent but the gait is bad. In walking, the hip is fixed and any forward movement of the leg is obtained only by a forward thrust of the whole pelvis. As flexion movements of the spine are less fatiguing than hyperextension, the leg is lined up at an angle of 5° hyperextension in relation to the bucket. Thus, even when the foot is behind the body, no lordosis of the lumbar spine is necessary. The whole leg is very heavy, and walking with it is very slow and fatiguing. A cer-

tain number of men wear it at work, because it enables them to stand in comfort and at the same time leaves both hands free, but it is rare to find a man who will wear it the whole day. As a means of locomotion it does not



A. *B.*

FIG. 13

TILTING-TABLE LEG

A. View from outer side, showing hip-joint locked in extension for walking.
B. View from inner side, showing hip-joint flexed for sitting.

compare for comfort or rapidity with crutches, and we find that most hip-disarticulation patients prefer the latter means of getting about.

It would be a mistake to leave the subject of lower limb amputations without a brief reference to those patients who have both lower extremities

amputated. One would think that having no feet in contact with the ground, they would be in the same position as tabetics and would be unable to maintain their balance except through their sense of sight. As a matter of fact this is not the case, and the double amputations have an excellent balance, maintained through the sensations received from the lateral pressure of the buckets on the stumps. They are unquestionably very severely handicapped, but it is impossible to predict, from the level of their amputations, how great this disability will be, as individual cases vary so greatly in their ability to get about. We sometimes see, for instance, men with two short thigh amputations doing astonishing things, and on the other hand we occasionally see men with two excellent-looking below-knee stumps who have given up altogether trying to wear their legs.

As a rule, however, having one good knee-joint is of the greatest importance, and in double cases, every effort should be made at operation to retain any possible portion of the leg below the knee, even if it makes what would ordinarily be considered a poor stump. A double amputation patient never walks far, and with two below-knee stumps, even if poor ones, can walk quite well for short distances; but if both amputations are above the knee, walking without two canes is very difficult and any going up or down stairs unaided impossible. Weight-bearing is harder on the stumps than if either amputation were single, and prolonged standing or walking out of the question. Most double amputation patients, however, make a big effort to wear, and as a rule do wear, both legs, or they at least wear one leg and get around on crutches. The latter means of locomotion is not good, but it gives a certain independence, and is preferable to the only other alternative, that of relying entirely on the wheelchair.

UPPER EXTREMITY

The problem of upper limb amputations and artificial arms is an altogether different one. While for walking, both legs are essential and the artificial leg does its work fairly well, for most of the actions performed by the upper extremity the second hand is not essential and we have to admit that the artificial arm at best makes a very poor substitute for the real one. The work performed by the normal hand consists, not in the constant repetition of simple movements such as are used in walking, but in an immense variety of movements which are co-ordinated and controlled by sensation. It is the lack of variety in movement and the lack of co-ordination and of the controlling sensation that constitute the great defects in the artificial arm. A man with one arm off performs most actions by means

of his remaining good arm, and the chief function of the artificial arm is to act as an aid to the good one in performing those actions that require two hands.

We have come to the conclusion, after many attempts at making mechanical hands ourselves, and after testing those made by private firms, that it is useless to attempt to make an efficient end-appliance in the form of a hand. Without the variety of co-ordinated movements and without the controlling sensation, a mechanical appliance consisting of five jointed digits is extremely clumsy, and adds a considerable weight to the arm at its end where it is most noticeable. When the man's work consists in the frequent repetition of similar actions, it is usually possible to fit his artificial arm with an end-appliance that answers his needs fairly well, but where any great variety of movements is required, the artificial arm, no matter what appliance it is fitted with, is disappointing. The most versatile of all the end-appliances are the various metal hooks, and with one or other of these, a man can, by perseverance, learn to do a great deal, and may be able to compete successfully in the ordinary labor market with two-handed men. As a rule, however, he fails to acquire the finer movements necessary in, for instance, the work of a mechanic, and we find most one-armed men either doing heavy labor, or preferably, if they are in any way fitted for it, doing clerical work, where they are under practically no handicap.

A great many men wear an artificial arm, not so much for what they can do with it as for the improved appearance it gives. As it is impossible to combine appearance and usefulness successfully and to make an arm and hand that look like the natural limb and yet are of any great use to the wearer, we have found the most satisfactory equipment for any given case to consist of two arms, one a dress-arm, light, comfortable, and resembling as nearly as possible the natural arm, but capable of doing nothing but the simplest of work, and the other frankly a work-arm, stronger and fitted with an end-appliance designed entirely for usefulness and bearing no resemblance to the normal hand. Needless to say, although the man possesses the two arms, one is worn much more than the other, depending on his occupation.

The best type of dress-arm we have succeeded in making is of rawhide, especially hardened over removable wooden moulds. The hand has its four fingers fixed rigidly in the semi-flexed position, and a thumb jointed at its base and opposed to the first, or first two, fingers by a spring. As a rule, for the sake of lightness and simplicity in the harness, the usual control cord to the thumb is dispensed with, and the only use to which this digit can be put is to hold objects placed under it by the opposite hand. For

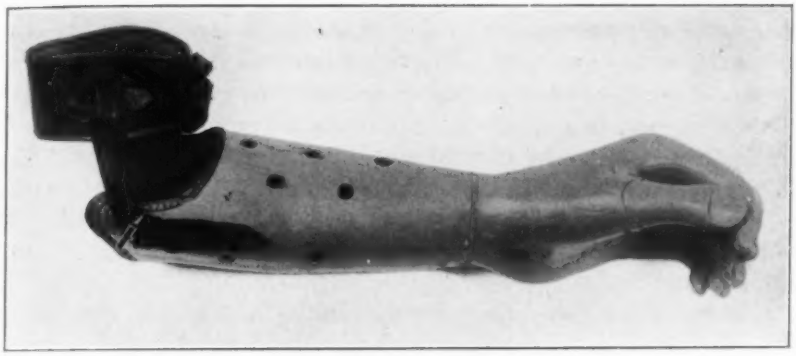


FIG. 14
LIGHT DRESS-ARM FOR BELOW-ELBOW AMPUTATION.

FIG. 15
LIGHT DRESS-ARM FOR ABOVE-ELBOW AMPUTATIONS.

below-elbow amputations (Fig. 14) the bucket extends well up on the forearm and the only harness is a strap just above the condyles to hold it on. Such an arm weighs about three-quarters of a pound and is very comfortable to wear. For above-elbow amputations (Fig. 15) a simple elbow-joint is made with its extension checked just short of the straight line by an elastic strap in front. A control may or may not be fitted to the joint, and the whole arm is held in place by a comparatively simple harness consisting of a light pad over the shoulder and a strap under the opposite axilla. This arm can be made to weigh on the average, harness and all, less than a pound and a half.

These rawhide dress-arms are very popular, and we find that they are worn regularly by numbers of our men who before would wear no arms at all. For office work particularly they are of a certain amount of use, but their chief features are their lightness and simplicity. It is surprising that the private firms do not go in more for this type of arm than for the usual arm weighing three or four times as much, with control cords to the elbow and thumb or fingers, with lock-joints at the elbow and wrist and with complicated and confining harness, and which, after all, are very little, if any, more useful. It would seem that lightness and comfort would be better selling points than the present method of attempting to prove, by means of demonstrators with a few tricks, a usefulness for the heavy mechanical arm which in reality does not exist.

In the work-arm the most important thing is to have an end-appliance suited to the work to be performed. Beyond this the arm must be strong and well controlled, and it is therefore necessary that the weight should be greater and the joints and harness more complicated than in the dress-arm. The bucket may be of willow, or better, as the fit is less important than in the lower extremity, of leather reinforced by steel.

In amputations below the elbow (Fig. 16) if any heavy work is to be done, increased stability is obtained if an above-elbow corset is used, fixed to the bucket by steels jointed at either side of the elbow. In above-elbow amputations (Figs. 17 and 18) the bucket encloses the stump and extends higher on the outer side than in the axilla, where it is cut low to avoid the axillary folds. The end-appliance can either be fixed directly to the end of the bucket (Fig. 17) or an extension the length of the forearm interposed (Fig. 18) with an elbow-joint controlled from the opposite shoulder and capable of being locked in any position. With the former arrangement the whole work-arm is, of course, considerably shorter than the normal arm. Greater control and greater power are possible, but the arm cannot be used unless the coat is off and the shirt-sleeve short. This

arrangement is the one usually preferred by heavy workers, but for those doing lighter work the addition of the jointed extension is usually an advantage. In all work-arms the retaining harness must be secure, and even for below-elbow cases a well-fitting shoulder pad and a strap under the opposite axilla are necessary.

As a rule, for forearm stumps the greater the length left, the greater the usefulness. For ordinary purposes a stump ending below the middle

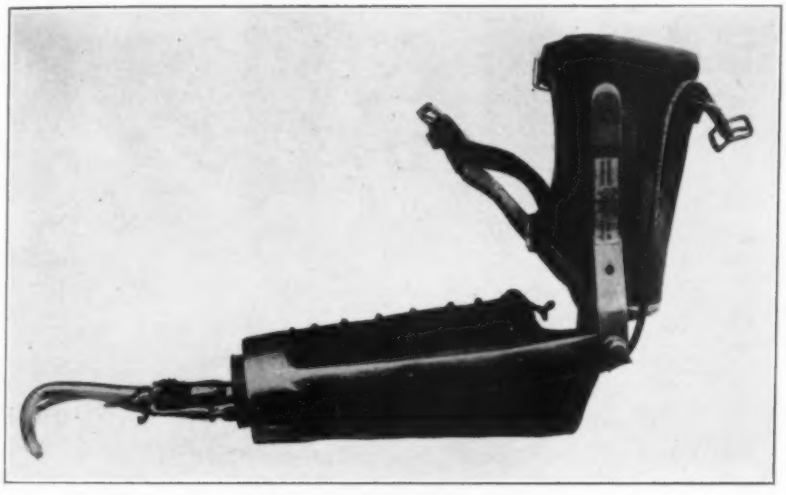


FIG. 16

WORK-ARM FOR BELOW-ELBOW AMPUTATION

The hook figured is the Dorrance hook, a split hook with its two arms held opposed by an elastic band and opened by a control cord from the opposite shoulder.

of the forearm flexes and extends the artificial arm fairly well. Above this level the control becomes less and less efficient. With a stump two inches long from the fold in front of the elbow a light dress-arm may be worn, but the length of the lever is not sufficient to activate a work-arm. Above this level it is practically impossible to keep the stump in the bucket, and therefore, if at least two inches cannot be retained from the bend of the elbow, it is better to amputate above the joint.

Amputations through the elbow-joint or just above it are not satisfactory, as the bulging condyles of the humerus make it difficult to fit a bucket comfortably. The best level is just above the supracondylar ridges, and

any level above this makes the stump increasingly less efficient. Stumps projecting less than two inches below the axillary folds are useless for the purpose of activating any arm with the ordinary above-elbow bucket, and

FIG. 17

WORK-ARM FOR ABOVE-ELBOW AMPUTATION

The end-appliance figured here is the Bowler hook, a hook having a positive grip worked by the opposite hand. It is fixed in this case directly to the end of the bucket.

with these short stumps a moulded leather cap, fixed to the bucket and fitting over the shoulder, is used.

There is little that need be said about the method of doing the operation. Both above and below the elbow, it is the anterior surface of the stump that comes forcibly into contact with the bucket, and, if possible, a

scar on this surface is to be avoided. There is none of the pull on the skin incident to weight-bearing, and a terminal scar, if not too large, is no great disadvantage even if adherent to the bone. The operation should therefore be done by equal or by long anterior and short posterior flaps, and anywhere in the limb care should be taken to cut all nerves short and allow them to retract as much as possible. Enlarged nerve-buds cause more trouble in above-elbow amputations than they do anywhere else in the body.

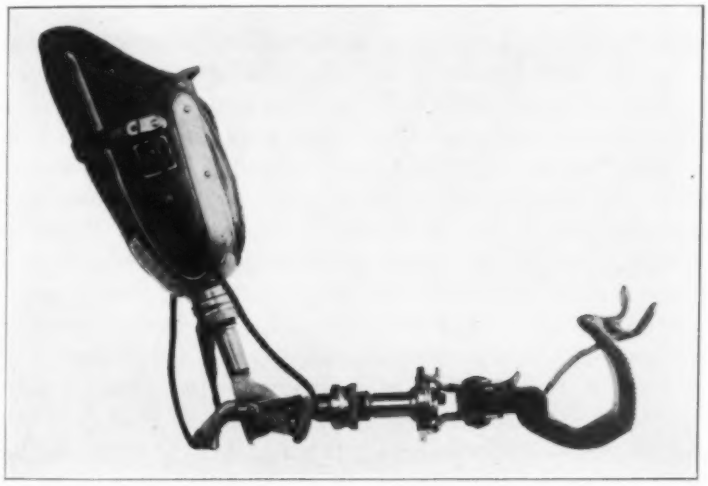


FIG. 18

WORK-ARM FOR ABOVE-ELBOW AMPUTATION

Here a controlled metal elbow-extension is interposed between the bucket and the hook. The attachments at both its ends are of identical pattern, so that in the same arm the hook may be fixed directly to the end of the bucket as in Fig. 17.

It seems hardly fair to express an opinion on cinematic amputations in view of our limited experience with them, but there are certain points that stand out for consideration. In any lower limb amputation, even when above the knee, the movements necessary are pretty well copied by the mechanism of the ordinary artificial leg, and the chief difficulty is to fit a bucket that will carry the weight in comfort. It would seem, then, that any attempt to improve movement by making muscle masses or muscle tunnels is not justified in the lower limb when such masses or loops interfere at all with the proper fitting of the bucket or necessitate a shortening of the stump.

In upper limb amputations the movements of the artificial arm leave much to be desired, and here it is possible that the cinematic method may be of advantage. We have had a number of low forearm amputation cases in which skin-lined loops have been made from the tendons. All these patients were fitted with hands or hooks that they could use fairly well. However, as the real test of the usefulness of any artificial arm depends not on the ability of its wearer to do a few difficult tricks with it, but rather on his willingness to wear it during his ordinary occupation, and as all our cases so fitted have abandoned their tendon-loop attachments after a thorough trial, we have been forced to admit that the method, in our hands at least, has not been a success. It may have been that our tendon-loops were not properly made or that our artificial limbs were mechanically imperfect, but the fact remains that all the patients so treated considered that the discomfort caused by the constant pull of the harness on the loop was out of proportion to the improvement gained in hand movement.

Much has been written since the War on the subject of amputations. In spite of this, we still frequently see in civil practice stumps amputated at unsuitable levels, with improperly fashioned flaps, or with contractures about the joints. There has been no general adoption of the temporary shrinking appliances which result in such great saving of time and money and which are every bit as important in civil as in military practice, and finally, there seems to be a surprising lack of knowledge of even the fundamental principles of artificial limbs. It would seem that the lessons of the War have not been generally learned, and it is felt that this further contribution, if it adds anything at all to the general knowledge, is justified.

MECHANICAL EMPLOYMENT OF SEQUESTRUM FRACTURE OF FEMUR

BY FRED H. ALBEE, M.D., SC.D., NEW YORK CITY

I have been induced to report this case for two main reasons: First, because a sequestrum was used for a very important purpose, which, so far as I am aware, has not been brought to the attention of the profession, — namely, to serve as a part of the bony skeleton as an extending influence in the restoration of the limb to increased length in a case of compound comminuted fracture with overriding, complicated by osteomyelitis. Second, it serves as a striking example of a large number of cases in which the quadriceps muscle has become fixed to the anterior lower surface of the shaft of the femur and thus either prevented flexion of the knee or seriously limited it, in which instance it is possible by plastic surgery to overcome this disabling affliction by extensive separation, by dissection, and by the implantation of a fascial and fat graft.

CASE REPORT

L. T., 17 years of age, the son of a prominent physician of Atlantic City, while riding in an automobile on October 12, 1917, was "ditched" by a moving van, throwing him against a telegraph pole and producing a compound comminuted fracture of the lower central portion of the shaft of the left femur (see Fig. 1).

The wound was opened widely and much foreign substance in the form of straw, sand, etc., was removed. Carrel-Dakin treatment was instituted and continued until November 6, 1917, when a Lane plate was applied (see Fig. 2). High pulse and rise of temperature appeared within twenty-four hours after operation. The fragments became displaced with two inches of shortening.

Operative note, Post-Graduate Hospital, January 9, 1918: Patient on the Albee fracture table. Old compound comminuted fracture, with extensive osteomyelitis. A Lane plate is fastened to the upper fragment, the screws falling from the lower fragment, which is displaced inward and backward; fragments overriding more than two inches (see Figs. 3, 4). Two strands of silver wire were removed. The complete circumference of the lower end of the upper fragment is white, extending for a distance of about four and a half inches upward. There is an inverted V-shaped line of sequestrating demarcation, indicating that this whole lower end of the upper fragment is dead and is still firmly engaged with living bone, because of the irregular serrated line of demarcation (see a, Figs. 3, 4, 5). There has been no attempt at callus formation, as far as the union of the fragments is concerned; there is an irregular cone-shaped piece of bone projecting into the lower fragment.

With some difficulty, by means of the traction table and a lever in the shape of a skid instrument placed between the bone ends, the limb was elongated sufficiently to allow the bone ends to come together. It should be pointed out, however, that the bone end of the superior fragment was the end of the sequestrum, as the whole lower end of this fragment was dead, as already stated. To prevent the bone ends from again slipping the lower end of the upper fragment was excavated in a V-shaped way with the motor saw, as indicated in Fig. 5, which is a photograph of the sequestrum which was removed at a later operation. With the same motor tool, the upper end of the lower

FIG. 1

Roentgenogram taken November 3, 1917, shows oblique nature of the fracture, and incidently prompt displacement of the fragments by muscle pull, in spite of treatment with a Lane's plate and two silver wires.

fragment was so shaped that it fitted into the concavity of the upper fragment. Because of the muscle and soft tissue shortening, these two ends were jammed firmly together, and there seemed little likelihood of any displacement, but to avert any possibility of such an accident, holes were quickly made with the motor drill and a heavy kangaroo suture was placed. It should be understood, however, that except for the mortise of one bone into the other the kangaroo tendon would be of no avail, so far as resisting the powerful thrust produced by the muscles of the thigh. This is especially proven by the fact that in the primary treatment, where the Lane plate and wires were applied to the fracture when the surfaces were oblique and were allowed to

remain oblique,—as demonstrated in Fig. 1,—immediate displacement and overriding occurred, because the end-to-end thrust was such that in the presence of the oblique bone end surfaces the Lane plate was dislodged and the fragments overrode. Had the bone fragments been mortised into each other by means of a motor saw they undoubtedly would never have been displaced, because in this event the greater the muscle contraction the firmer the contact of the bone ends.

FIG. 2

Shows bone fragments in good apposition and Lane's plate in position.

The wound was left wide open and packed with iodoform gauze, the bone junction being located at the bottom. A plaster-of-Paris spica, extending from above the costal margin to the base of the toes, was applied with the leg in moderate abduction. A long narrow window was made in the plaster directly over the wound for the purpose of future dressings. Because of the danger of damaging the plaster-of-Paris spica, Carrel-Dakin treatment was not carried on in this case, also it was not found necessary, as there was no active infection and the wound healed promptly. The patient was discharged from the Hospital on April 2, 1918.

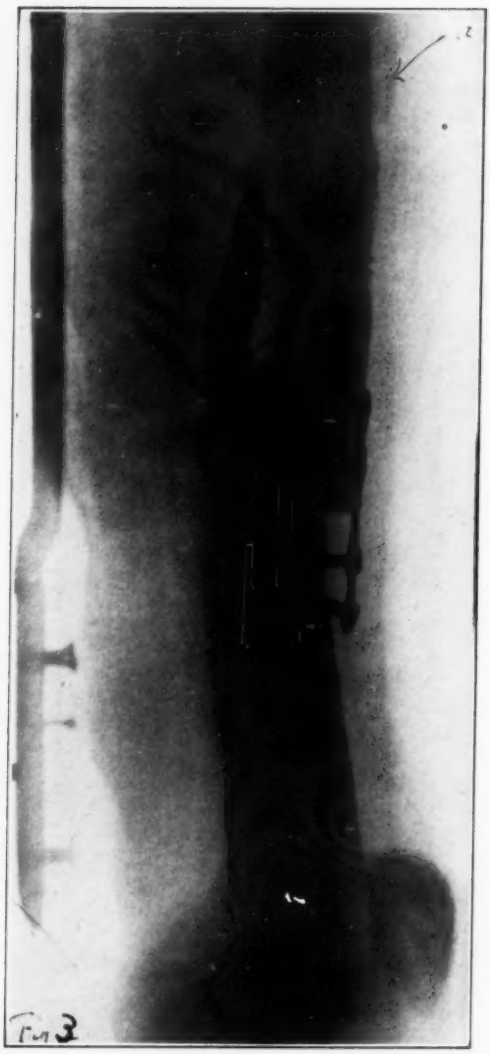


FIG. 3

Bone fragments shown displaced and overriding. Upper end of sequestrum is shown at A.

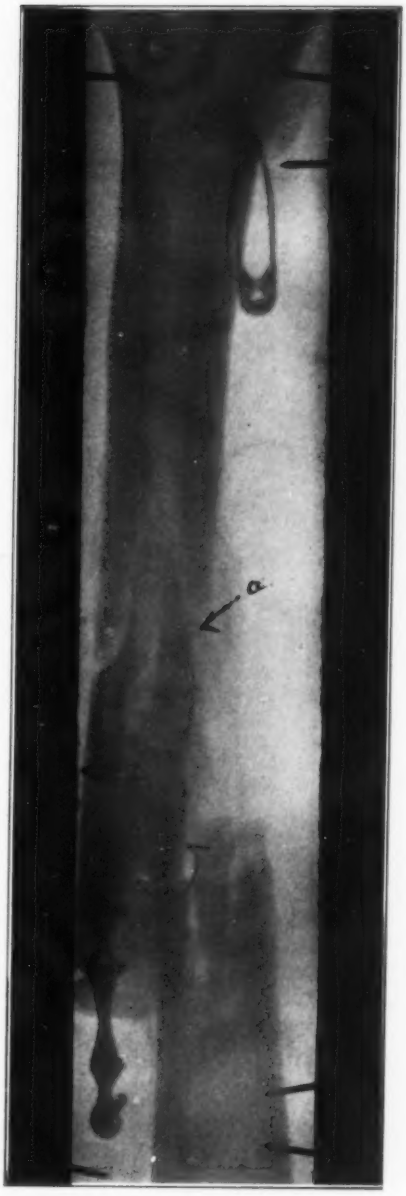


FIG. 4

Line of sequestrating demarcation is shown at A. Also marked displacement of fragments.

Roentgenograms through the cast showed marked proliferation of the bone in the form of an involucrum and callus around the bone ends, and on February 25, 1918, through the window in the cast the sequestrum which is shown in Fig. 5 was removed. A firm union of the fragments

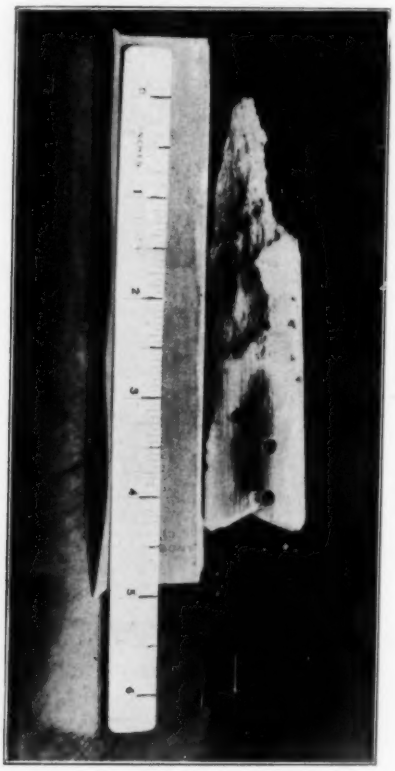


FIG. 5

Photograph of sequestrum nearly 4½ inches long and comprising entire thickness of shaft of femur.

had occurred. From this time on the wound progressed most favorably and was almost completely healed, there being only a small granulating surface when the patient was discharged on April 2, 1918. Physiotherapy was immediately instituted at the patient's home, but in spite of the most strenuous baking, massage, and manipulation, only a few degrees of motion at the knee could be secured.

On April 7, 1920, the patient was readmitted to the Post-Graduate Hospital for the purpose of securing motion either by breaking up the

FIG. 6

Shows final restoration of loss of bone, and firm union on May 20, 1919.

adhesions under an anesthetic or by a plastic operation to free the adherent quadriceps from the femur.

On April 8, 1920, under complete anesthesia, an attempt was made to bend the knee, but it was found impossible to increase the motion by even a few degrees. The thigh was then prepared for an open operation,

and through an extensive incision over the outer aspect of the thigh the quadriceps muscle was bared from the femur from just above the knee joint to the mid-thigh region. A large graft of fascia lata and fat, obtained from high up on the thigh, was implanted between the shaft of the femur and the dissected muscle. The wound healed by primary union and physiotherapy was again instituted.

In spite of strenuous treatment, motion to only 30 degrees was obtained, and on May 23, 1921, the patient was again admitted to the Post-Graduate Hospital, and under general anesthesia it was attempted to forcibly flex the knee. As tense fascial bands on the anterior and lateral aspects of the lower portion of the thigh prevented this, subcutaneous fasciotomies were done, which allowed the knee to be flexed well beyond a right angle.

This patient has since been under the constant observation of myself and his father, and now has a limb with only three-quarters of an inch shortening, and free and active painless flexion to beyond a right angle.

A THEORY AS TO THE CAUSE OF PERTHES' DISEASE BASED ON ROENTGENOLOGIC FINDINGS

BY JOHN M. BERRY, M.D., ALBANY, N. Y.

The symptoms, clinical course, pathology, and treatment of the disease entity variously known as Legg's disease, Legg-Calvé disease, Perthes' disease, coxa plana, pseudocoxalgia, osteochondritis deformans juvenilis, etc., are now fairly well understood, but the cause remains an illusive and fascinating problem.

The etiologic speculations and theories have practically narrowed down to three: (1) the infective theory; (2) the traumatic theory; and (3 and 4) the congenital theory. The trouble is that no one of these theories seems to explain all cases. The nature of the disease in question is such that it has to be studied mainly by X-ray examination and clinical observation rather than histologically or by experiment; consequently conclusions as to cause must be arrived at speculatively or theoretically. If a theory as to cause has to be accepted, however, it should at least be one that will cover all cases.

The following thirteen cases are presented for study and discussion as to their bearing on the etiology of what, for the sake of brevity, will be called Perthes' disease.

Cases I and II are excellent examples of Perthes' disease in which roentgenograms of the lesion are practically diagnostic of the condition. The same roentgenographic appearance of the hip joint has been frequently observed after reduction of congenital dislocation of the hip and reported as Perthes' disease. The following three cases are of this character.

The frequency with which the bone changes characteristic of Perthes' disease follow reduction in congenital dislocation of the hip suggests that there may be some relation between the two conditions. Bearing upon this a roentgenologic study of cases of congenital dislocation of the hip shows some interesting facts which are exemplified in the three following cases.

After studying the roentgenograms in Cases VI, VII, and VIII, it is plainly seen that the condition shown is more than a hip out of joint. It is a developmental defect; one that tends to persist; and in some cases may never be fully corrected. Broca and d'Intignana,[7] in a study of the end

results of congenital dislocation of the hip, found that in 257 cases perfect reconstruction of the joint was found in only twelve.

What is the cause of this?

A satisfactory explanation can be found in the theory of partial arrested development.

CASE I. FIG. 1

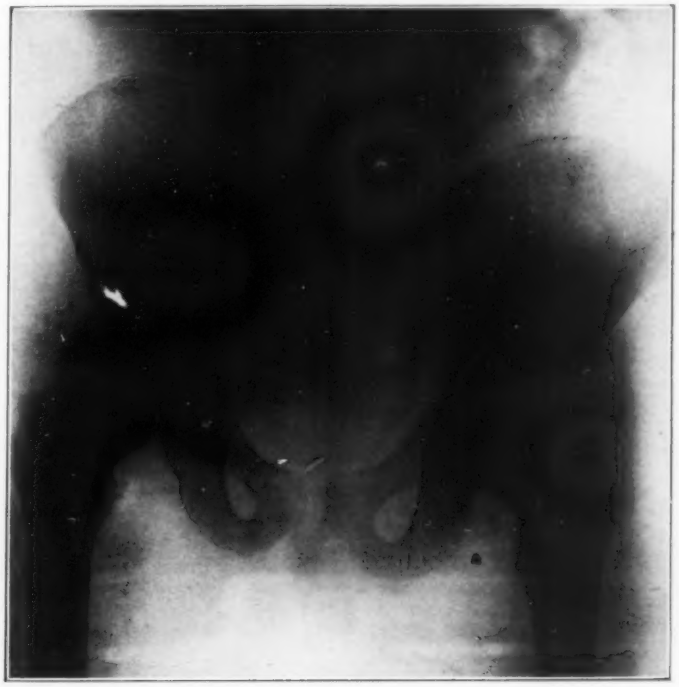
Roentgenogram of the hips of a girl six years old. Child limps. Limp was first noted three years ago. Child has never complained of pain. The roentgenogram is typical of Perthes' disease in both hips: shows a fragmented epiphysis and distorted acetabulum. This patient was seen about a year later in a clinic conducted by the late Dr. Lovett, who confirmed the diagnosis.

Evolution assumes that man has developed from simpler animal forms, and the theory of biogenesis maintains that the individual, in its development, tends to repeat the evolutionary history of its own race.[5,6]

In the human embryo, while it is not possible to visualize an exact resemblance between its successive stages of development and the succession of types which compose the scale of the animal kingdom, yet there are numerous features seen during the development of the embryo which can only be explained by supposing that the human body in the course of

its evolution has passed through those stages which are seen represented in simpler forms.

Man has departed greatly from primitive types in the structure of his brain and trunk, but in the elements which enter into the formation of his



CASE II. FIG. 2

Roentgenogram of the hips of a boy eight years of age who complained of limping. The left hip shows the typical lesion of Perthes' disease: a fragmented epiphysis and distorted acetabulum. This case was observed over a period of several years and ran a characteristic course.

limbs he has retained more of the ancestral features. The lower limbs of man are supposed to have developed from the pelvic fins of fishes and the hind legs of reptiles. In the human foetus the lower limbs begin to appear at the end of the third week of embryonic life. They appear first as a "bud." In the fourth or fifth week "webbed" digits appear, and these become free during the third month. Sometimes children are born with

webbed digits (syndactylism), showing that there was a partial arrest of development at that stage. Other examples of what is believed to be partial arrested development are hare lip, cleft palate, imperforate anus, congenital elevation of the scapula, etc.

During the seventh week the cartilage centers have appeared for the majority of the bones of the lower extremity and the three cartilaginous

CASE III. FIG. 3

Roentgenogram of the hips of a boy three years of age. Roentgenogram was taken two years after a reduction of a congenitally dislocated left hip. Previous to the reduction the epiphysis was smooth in outline. Note the fragmentation and irregularity of the epiphysis and the large, shallow, irregular acetabulum in the affected hip as compared to the unaffected hip.

elements, ilium, ischium, and pubis, meet in a Y-shaped acetabular suture. In the latter part of the second month the hip joint is formed by: first, cartilaginous outgrowths from all three elements to form the acetabular cup; second, the separation of the head from the shaft of the femur, by the formation of the neck.

At this time the limb is at right angles to the axis of the body and rotated outward, so that the extensor surface of the knee is directed up-

ward with the great toe in front and the little toe behind. The rotation which brings the embryonic limb into the adult position begins at this time and appears to occur at the junction of the limb girdle with the trunk. The recent work of Carey[8] with pig embryos shows that the hip joint cavity appears in pig embryos, 19 to 24 mm. in length, and that this cavity

CASE IV. FIG. 4

Roentgenogram of the hips of a girl three years old. Roentgenogram taken one year after a reduction of double congenital dislocation of the hips. The hips are beginning to show the changes of Perthes' disease.

formation coincides with the first adducting action in the rotation of the hind limb.

The limb structure found in human embryos at the end of the second month of growth, and also the position of the limb in relation to the trunk, corresponds to that found in adult reptilian development.

A partial arrest of growth at the reptilian stage of development, therefore, would result in an imperfectly formed, shallow acetabulum, and a

small, malformed head of the femur, and when rotation of the limb took place, in order to make the erect attitude possible, a dislocation of the head of the femur would be apt to occur. Perna[9] believes that malformations of the human acetabulum correspond to forms found in lower animals,

CASE V. FIG. 5

Roentgenogram of the hips of a girl three years old. Roentgenogram taken one year after a reduction of double congenital dislocation of the hips. The left hip shows Perthes' disease.

and Lorenz[10] believes that congenital dislocation of the hip is due to arrested development.

If we accept the theory of partial arrested development as the explanation of congenital dislocation of the hip, what, then, is its relation to Perthes' disease?

Joroschy[11] believes that late disease of the hip after non-operative correction of congenital dislocation is a manifestation of some inhibition of the normal development of the bony hip joint.

For a long time it was the opinion of anatomists that epiphyses were confined to the skeletons of mammals, but Moodie,[12] Parsons,[13] and others have reported their presence in some reptiles. The epiphyses found in reptiles, however, are not always bony: sometimes they are merely calcified cartilage. It would follow, therefore, that a human hip joint which had

CASE VI. FIG. 6

Roentgenogram of the hips of a girl six years old. Double congenital dislocation of the hips, unreduced. Note the shallow distorted acetabula and the small deformed epiphyses of the heads of the femora.

been partially arrested in development at the reptilian stage would have a poor quality of epiphysis.

When a dislocated hip of this type was reduced it is easy to speculate that the trauma would affect the circulation and be sufficient to cause the already poor quality of epiphyseal tissue to break down, bringing about the changes of Perthes' disease. If the trauma was sufficient we would expect to find evidence of Perthes' disease where there was no evidence of

poor quality of epiphyseal tissue. Muller[14] has shown experimentally with animals that severe trauma to the hip joint affecting the circulation produces bony changes similar to Perthes' disease. Case IX would seem

CASE VII. FIG. 7

Roentgenogram of the hips of a girl eight years old. Roentgenogram taken five years after a reduction of double congenital dislocation of the hips. Both acetabula are shallow and distorted, but particularly the left. The first impression in looking at the roentgenogram is that the left hip is not reduced; but a closer examination of the roentgenogram and a physical examination of the patient shows that the head of the femur is in the acetabulum. The explanation of the appearance is that the acetabulum has migrated upward. The epiphysis of the head of the right femur shows a slight Perthes' disease with outward displacement of the epiphysis.

to prove that a severe trauma to an apparently normal human hip joint can produce Perthes' disease.

Following the same line of reasoning as above, Perthes' disease by itself, without congenital dislocation, would simply be a poor quality of hip joint which breaks down under trauma. Nové-Josserand[15] believe that

the bone in cases of Perthes' disease is abnormally susceptible to trauma and infection and that it reacts in a special way to influences that do not affect normal bones.

CASE VIII. FIG. 8

Roentgenogram of the hips of a girl twelve years old. Roentgenogram taken nine years after reduction of a congenitally dislocated left hip. An arrow points to the affected hip. Note the irregularity of the wall and distortion of the acetabulum of the affected side as compared to the acetabulum of the unaffected side. Also note the flattening of the epiphysis of the head of the femur of the affected side.

If the above speculations are correct we would expect to find cases with congenital dislocation of the hip on one side and Perthes' disease on the other. Shedlov[16] mentions such a condition and a similar one is presented in Case X.

If we believe that Perthes' disease is the result of trauma acting on defective epiphyseal tissue then we would expect to find defective epiphy-

CASE IX. FIG. 9a

Roentgenogram of the hips of a boy nine years of age who has had a traumatic dislocation of the left hip. The acetabulum and head of the femur appear normal.

CASE IX. FIG. 9b

Roentgenogram of the same patient two days later. The dislocated left hip has been reduced.

CASE IX. FIG. 9c

Roentgenogram of the same patient six months after reduction of dislocated hip. Note the beginning Perthes' disease.

CASE IX. FIG. 9d

Roentgenogram of the same patient, eleven months after reduction of dislocated hip. Note the advanced Perthes' disease.

This case is reported through the courtesy of Dr. Edgar A. Van der Veer.

CASE X. FIG. 10

Roentgenogram of the hips of a girl nine years old. History of limping with left leg since she began to walk. Roentgenogram shows a congenital dislocation of the left hip and a Perthes' disease of the right hip.

CASE XI. FIG. 11

Roentgenogram of the left wrist of a man about thirty-five years of age who gave no history of trauma or infection of the wrist that would account for the unusual atrophy and distortion of the lower epiphysis of the radius.

seal tissues in joints other than the hip, and, consequently, changes similar to those of Perthes' disease.

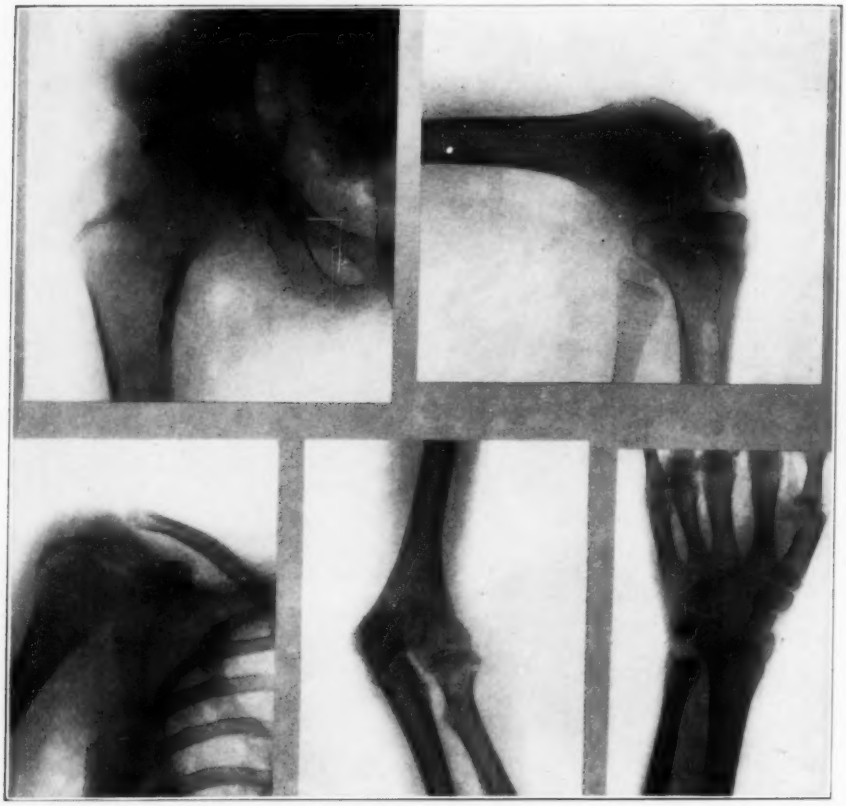
Several diseases whose clinical cause and pathology are similar to that of Perthes' disease have been observed. These are: osteochondritis of the spine (Calvé[17]); tarsal scaphoiditis (Lecène and Manchet[18]); osteochondri-

CASE XII. FIG. 12

Roentgenogram of the right wrist of a man about twenty years of age. No history of trauma or infection to account for the appearance of the semilunar bone. Note the resemblance to Köbler's disease of the tarsal scaphoid.

tis of the second and third metatarsals (Heitzman[19]); and Schlatter's disease (Osgood[20]).

There have come under the writer's observation two cases in which roentgenologically the end results suggest that a disease similar to Perthes' disease had existed in situations other than any above mentioned: one of these was in the epiphysis of the lower end of the radius; the other in the semilunar bone of the wrist.



CASE XIII. FIG. 13

Roentgenogram of various joints of a boy fourteen years of age. This patient was admitted to the Childs' Hospital in Albany complaining of pain in the left hip. He gave a history of having had a peculiar walk for years. The pain in the left hip had been present for three weeks and the left thigh was beginning to flex on the abdomen. Tuberculin tests and Wassermann test were negative and there was no leucocytosis. Roentgenogram of the painful hip (a) showed the bony changes of Perthes' disease, as did also the opposite hip. While making a physical examination other joints of the body seemed somewhat distorted, and roentgenograms showed changes in the various epiphyses similar to those seen in Perthes' disease. Roentgenograms of some of these joints are here reproduced: shoulder (b), knee (c), elbow (d), wrist (e).

Cases XI and XII are isolated cases of unusual bony findings without definite clinical history, but a third case has come under the writer's observation which seems to show bony changes similar to Perthes' disease in practically every joint in the body.

CONCLUSION

A theory as to the cause of Perthes' disease which seems to cover all cases is that it is due to defective epiphyseal tissue plus trauma and that trauma alone, if severe enough, may cause the disease.

BIBLIOGRAPHY

1. Platt: British Journal of Surgery, Vol. IX, No. 35, 1922.
2. Noble: Jour. of Bone and Joint Surg., Vol. VII, No. 1, 1925.
3. Calot: Presse Médicale, Jan. 14, 1922.
4. Jansen: Jour. of Bone and Joint Surg., Vol. V, No. 3, 1923.
5. Leighton: Embryology, p. 84.
6. Keith: Human Embryology and Morphology, Fourth Edition.
7. Broca and d'Intignana: Rev. d'orthop., Par., 1921, 3, s., VIII, 353–377.
8. Carey: Amer. Jour. Anat., May, 1921.
9. Perna: Chir. d. Org. Movimento, Bologna, 1922, VI, 485–568.
10. Lorenz: Die sogenannte angeborene Hüftverrenkung: ihre Pathologie und Therapie. Ferdinand Enke: Stuttgart, 1920.
11. Joroschy: Bruns Beitr. z. klin. Chirurgie. Tübingen. 132: 701, No. 3, 1924.
12. Moodie: Am. Jour. of Anat., 1908, Vol. VII, p. 443–467.
13. Parsons: Jour. Anat. and Phys., XXXVII, XXXVIII, XXXIX.
14. Muller: Bruns Beitr. z. klin. Chir. Tübingen 132: 490, No. 3, 1924.
15. Nové-Josserand: Archiv. Franco-Belges de Chir. XXV, No. 7, April, 1922.
16. Shedlov: Journal Lancet, 43: 488–494, 1923.
17. Calvé: Journal of Bone and Joint Surgery, VII, No. 1.
18. Lecène and Mouchet: Rev. d'orthop., XI, 1924.
19. Heitzmann: Klin. Wchnschr., II, 1923.
20. Osgood: Boston Med. and Surg. Jour., Jan. 29, 1903.

THE DANGER IN THE USE OF LIPIODOL IN THE DIAGNOSIS OF OBSTRUCTIVE LESIONS OF THE SPINAL CANAL

BY WILLIAM SHARPE, M.D., AND CARL A. PETERSON, M.D., NEW YORK

As a means of facilitating the differential diagnosis and accurate localization of obstructive lesions of the spinal canal, and thus particularly of tumors of the spinal cord and meninges, compression of the spinal cord by adhesions of former meningeal exudate and of organization-residue of unabsorbed hemorrhage, together with extradural compression of the spinal canal by traumatic and tuberculous kyphoses, the injection of lipiodol into the spinal theca was first suggested by Sicard of Paris in 1921, and strongly supported by DeMartel. Since then, and especially within the past few months, this method of diagnosis has been most favorably discussed in the literature by Sargent, Russell, Babinski, Ironside and Shapland, Laplane, Moniz, Mixter, and others. No unfavorable case reports have been found in the literature, and as lipiodol is now being used more and more extensively, we feel it advisable to report our observations in three cases.

Although it is comparatively rare that a surgical lesion of the spinal cord cannot be diagnosed and accurately localized by the usual neurologic examinations and especially by careful sensory tests, and long before the lesion has advanced to a degree causing a more or less complete obstruction of the spinal canal, yet there are cases where even the most painstaking, thorough neurologic examinations, aided by the Queckenstedt and combined cisterna magna-lumbar puncture tests do not reveal sufficient information as to the character and accurate localization and extent of the spinal lesion to warrant an operative procedure other than an exploratory laminectomy. To avoid the use of the exploratory laminectomy with negative findings, and to localize the lesion, particularly its upper and lower borders in relation to the vertebrae, most accurately and as early as possible, many substances have been considered for injection into the spinal theca to be outlined about the site of the spinal block by roentgenograms, but no satisfactory material was found until Sicard stated that lipiodol, a 40% iodine solution in poppy-seed oil and opaque to the X-ray, was safe and non-irritating to the delicate membranes and tissues of the spinal cord.

In the belief that the injection of lipiodol into the spinal theca was a harmless test for the accurate localization of the upper and lower levels of

spinal block in selected cases in which no definite diagnosis and localization could be made by careful neurologic examinations, 1 cm. of the iodized oil preparation of Lipiodol Lafay, as manufactured by Doctor L. Lafay,

FIG. I A.B.

Lateral view of lumbar spine 14 months after injection of lipiodol by lumbar puncture. Several elongulated globules of unabsorbed lipiodol are shown in a patient developing vesical urgency and pain over dorsum of right foot since the injection.

Pharmacien, Paris, and considered non-irritating to spinal structures, was injected by lumbar or cisterna magna punctures into the spinal theca of three patients, our only three cases in which this method has been used. The results were of definite diagnostic value in all three cases, but in one

case such an inflammatory reaction to the arrested lipiodol occurred at the site of the spinal block in the mid-dorsal area that the patient's symptoms and signs were aggravated to a degree necessitating its removal at a

FIG. II. S.T.

Unabsorbed lipiodol in the caudal theca of spinal canal 15 months after injection in a patient developing a small irregular hypesthetic area over dorsum of each foot and also vesical urgency. The oval globule has assumed an hour-glass shape upon the patient being placed in the Trendelenburg position and is undoubtedly encysted.

later operation of laminectomy, at which were disclosed two encysted globules of lipiodol surrounded by numerous newly formed adhesions. The fact also that lipiodol in this case was temporarily, at least, non-absorbable within a period of five and one-half months aroused our interest

in ascertaining (at an interval of fifteen months later) whether the lipiodol injected in the other two patients was still unabsorbed—as it proved to be.

Fig. III. V.L.

Irregular globule of unabsorbed lipiodol 16 months after injection at lumbar puncture in a patient developing vesical incontinence. It was in this patient that a later laminectomy was performed to remove the encysted lipiodol in the dorsal spine and there was disclosed a severe inflammatory reaction of new tissue formation about the unabsorbed lipiodol.

Roentgenograms of all three patients now revealed the unabsorbed lipiodol in the spinal canal even after an interval of fifteen months following the injection, and since it was found encysted and surrounded by a fibrous tissue of an inflammatory reaction in the first case, as disclosed at operation

in the mid-dorsal area, and changes of posture do not affect the position of the lipiodol in numerous roentgenograms in the other two cases, it is strongly suggestive that the unabsorbed lipiodol is also encysted in these two cases. Since the lipiodol, however, was injected in these two patients by lumbar puncture, it has fortunately collected in the lowest portion of the spinal theca in the sacral area, so that the symptoms and signs of its presence are not marked. Our experience, therefore, is indeed discouraging—not with the idea and method, but with the substance lipiodol itself used for the injection, and it is our opinion that lipiodol in its present irritating and non-absorbable form should not be used; or, at least, if no other satisfactory substance for injection can be found, then used only at lumbar puncture with the patient in the Trendelenburg position so that, unabsorbed, it can later sink to the less important structures neurologically of the caudal spinal theca and its presence produce little or no harm clinically; also used as a last resort to confirm the neurologic findings in those cases where a subsequent operation is most probable, so that this irritating, non-absorbable "foreign body" can be entirely removed; or, better still, in doubtful cases the utilization of the former operative procedure of exploratory laminectomy. The use of air injected into the spinal theca by lumbar and cisterna puncture may be sufficiently satisfactory for roentgenograms in many cases until a safe non-irritating and absorbable substance has been found for such injections.

The method employed in the following three patients has been the same: 1 cm. of lipiodol was introduced into the spinal theca by cisterna or lumbar puncture, and by elevating the head and shoulders or by lowering the head and shoulders, respectively, the lipiodol gravitated quickly toward the level of the suspected spinal block. When this heavy oil was injected by cisterna puncture, the patient's head and shoulders were elevated to the sitting position; when introduced by lumbar puncture, the hips were elevated with the head and shoulders lowered in the Trendelenburg position. In the presence of complete spinal block, the lipiodol was thus arrested at the upper and lower levels and early subsequent (from one to twenty-four hours after injection) X-ray examinations of the spine revealed the globules of lipiodol. The gravitation of the lipiodol in the absence of spinal block is rapid—within five to seven minutes thoughout the spinal canal. In the presence of partial thecal obstruction, such as caused by adhesions of unabsorbed hemorrhage and meningeal exudate, the lipiodol may be temporarily arrested and then be filtered slowly past the point of partial blockage; numerous particles of lipiodol may be indicative of adhesions. Introduction of lipiodol by lumbar puncture necessitates the un-

comfortable head-down position following the injection in order to maintain the oil at the lower level of spinal block during the subsequent examination, whereas the injection of lipiodol into the cisterna magna permits the comfortable sitting posture to be maintained until the clinically important upper level of the spinal block has been accurately localized by the X-ray.

IMPRESSIONS

The use of lipiodol on this service has been effective in demonstrating the level of spinal block, but it has been noted that the presence of this iodized oil preparation in the spinal theca has resulted in the aggravation of clinical symptoms and signs as demonstrated by our case-reports.

It is realized by us that three cases are indeed a small number from which any definite conclusions may be drawn, and yet since the lipiodol used has been tested and has been reported aseptic and chemically pure, the complications observed concerning the inflammatory reaction to its presence in the spinal theca—even necessitating in one case an attempt to remove it by a laminectomy—make it advisable to express at least a word of caution regarding its use, especially as an early, routine, and confirmatory method of diagnosis. The fact that it is apparently non-absorbable is in itself a potential danger.

THE CLASSIFICATION OF ARTHRITIS

BY CHARLES F. PAINTER, M.D., BOSTON, MASS.

Among the many moot questions which perplex general practitioners and orthopaedic specialists there is none, perhaps, which causes more difficulty and about which there is more diversity of opinion than arthritis. If one takes the trouble to scan the literature, surprise that there could be so many views upon any one subject will be the outstanding impression with which one completes such a survey. Tuberculosis, syphilis, gout, gonorrhea, and acute metastatic or pyogenic infections can be almost immediately excluded, leaving a residue which comprises the debatable subjects. The approach to an investigation of any arthritic problem must first of all be with a mind untrammelled by preconceived notions as to focal infection, basal metabolism, or endocrinology. Familiarity with the facts in respect to these matters is, of course, essential, but the time to make one's appeal to their arbitrament is at the end of the study and not at its beginning.

History taking is, if anything, of more significance in reaching the right basis for classification of an arthritis than is the physical examination. A thorough survey of the family history with special reference to arthritic diatheses should first be made. It may be that a description of the visible joint lesions, where such a family history is obtainable, can be procured. If so, it will perchance point to the type of joint lesion from which these ancestors suffered. When it is not possible to secure a description of objective appearances it will sometimes be recalled that a particular forbear had a limp or complained of stiffness or gave a history of lumbago, sciatica, or some other stigmata of arthritis. These observations will be of significance when put together with the personal history and physical examination of the patient. A background of this sort is very suggestive, when obtainable, because hereditary transmission in one type of arthritis seems extremely common. It is not that the arthritis is inherited, but the physical "make-up" which lends itself to the establishment of an arthritic diathesis is transmitted. It is for this reason that any light which may be obtainable on the character and location of arthritic lesions in forbears as well as the age of incidence of such lesions is of so much importance. A perfunctory inquiry of a patient as to whether "any of your family had

rheumatism" is a useless interrogation unless accompanied by rigid cross examination.

Having spent sufficient time on this matter, the procedure should then be to secure a history of the patient's present illness and previous diseases, having constantly in mind that a sick person attaches no importance to many things that may be of vital significance, and that one must not trust too implicitly to an invalid's judgment or observation. The toxic types of arthritis behave like all inflammatory affairs clinically, and should, from an etiologic standpoint, hark back to a toxic origin, and though it may not be possible always to establish the proof of focal infection, still there will usually be a history of such a cause definite enough to admit of consideration. So many sub-infections occur after the primary one may have become extinct that it is difficult to place responsibility. Sinus infections with long periods of latency, tonsils of the buried variety, middle ears, mastoids, gall bladders, appendices, seminal vesicles, pus tubes, osseous infections, gastro intestinal stasis and fermentation, constitutional infective diseases, like influenza, typhoid, vegetative endocarditis, and pneumonia, should all be subjects of inquiry.

The factors which favor the metabolic arthritis (hypertrophic, osteoarthritis) are two, viz: failure to eliminate bodily waste with sufficient rapidity and trauma, occupational or otherwise. The distribution of lesions among men and women is suggestive, as is the common age of incidence. Spines and hips in men, knees and phalangeal joints in women, support the idea that occupational trauma is a dominant factor. The significance of age incidence lies in the fact that most cases develop at a time when bodily activities are tending to wane, but food is ingested as at the more active period. Habits are a little more sedentary, and superfluous weight bespeaks the fact that more food is taken in than the body economy demands. Stimulation of excretory function does certainly aid in controlling existing symptoms.

In the atrophic type the conspicuous etiologic suggestions which one meets in many patients, suggestions which fit in well with the character of lesions which characterize this arthritis, are a history of nervous shock, sometimes from fright or grief, or more often from an accumulation of nerve-trying circumstances. It is far more common among women than men. Childbearing, particularly when this has been of frequent occurrence and with but little time between pregnancies, seems capable of setting the stage for this variety of arthritis. The wear and tear of life bears more heavily on some than on others and doubtless a lower threshold of nervous stability may have something to do with permitting the annoy-

ances and physical hardships of life to crowd in upon those so constituted than upon others.

The manner of onset, clinical course, duration, and associated conditions of health, history of injury, emotional excitement, endurance, the wear and tear of life, temperament, occupation, etc.,—all can be counted upon to furnish data which may be helpful in arriving at a diagnosis. Experience in investigating arthritic cases soon gives one a clue as to what "leads" to develop in the taking of histories. In the first place where the joint changes are apparent in the hands or elsewhere, one gets a line on the type from the first impression. Take for example the hands. The terminal phalangeal joints are rarely involved in any but one type of arthritis (hypertrophic) and the appearances in this locality are quite characteristic. As one goes back from the terminal finger joints the diagnostic problem is pretty generally confined to a differentiation between two types, one of which is probably of toxic origin, whereas the other is more likely the result of nutritional (atrophic) disturbances in the articulations. It is rare that these lesions are confined to the small joints, so that the diagnostic problem, except in cases where the smaller articulations are first to be involved, is not a very complicated one. When the large joints show priority over the small ones, and particularly when a single joint is affected, decision rests between infection and disturbed metabolism as a cause. Mon-articular, nutritional (atrophic) arthritis does not, so far as I know, occur. Distribution of lesions is therefore of some diagnostic significance, and even when a case is seen late, after extensive involvement has taken place, it is well worth while to go minutely into the history of incidence of the lesions in the various joints concerned. In certain of the nutritional disturbances there is a tendency for them to appear symmetrically on the two sides of the body as though it were a segmental, spinal cord affair.

The age of the patient at the time of the incidence of joint lesions is suggestive. Metabolic disturbances rarely occur before forty or forty-five and are practically all established by sixty, whereas those of toxic origin are most common from thirty to forty-five, with a few appearing in childhood (Still's disease) and a few as an accompaniment of advanced senility. To this early adult period we may look for the beginnings of a majority of the nutritional (atrophic) cases.

Absence of constitutional symptoms characterizes the metabolic group as a rule. By this is meant that such patients are not ill. They feel as vigorous as ever and have no complaints to make except that some one or more joints are lame or painful and their functional activity is conse-

quently impaired. The toxic cases reveal evidences of involvement of their general health to a greater or less degree. They show this in asthenia, anorexia, secondary anaemia, and, if temperature and pulse curves are plotted, will usually carry a pulse rate out of proportion to any slight elevation of temperature they may have, and they usually do have a degree or a degree and a half. No such picture will be presented by the metabolic or atrophic types of joint lesion at any time in their course.

Further information to be gained by a first inspection relates to the character of joint lesions and is fairly constant. The toxic lesions are characterized by capsular thickening. In the joints of the fingers, for example, where the skin fits tightly over the capsule, the swellings are typically spindle-shaped; where the skin is looser, as in the knee, the outline of the joint is well defined, and palpation will furnish further information. Deformity, exclusive of swelling, is caused by spasm or contracture; in certain cases by osseous erosion, by cartilaginous atrophy, and proliferative spur formation, so placed as to block mechanically the assumption of a normal relation of the bones making up the joint. It is only in the toxic cases that spasm operates permanently to produce flexion deformity. Proliferative spur formation, seen in various joints, e.g., the hip (morbus coxae senilis), the knee, and the terminal phalanges of the fingers (Heberden's nodes), is caused by the metabolic type. The atrophic variety manifests interosseous atrophy, atrophy of cartilage at the joint line, subluxation at joints, and, in the fingers, abduction of the phalanges at the metacarpo-phalangeal articulations when the hand is prone. When palpation is practised, surface temperature, character of swelling, and cause of deformity or limitation of motion is sought. In the metabolic type the enlargements are osseous, almost entirely. Rarely is there excess of fluid or capsular thickening, and atrophy of muscles above and below the joint is less than in the toxic subjects. The atrophic cases in the early stage show some increase in surface temperature and capsular thickening, but later this gives way to a marked atrophy of all structures entering into the make-up of a joint, as well as to atrophy of the skin, disturbance of the heat-regulating mechanism, and striation and proliferation of the nails. Charcot's arthopathy has certain close resemblances to this atrophic type so far as surface temperature and capsular thickening is concerned. I have observed in both these types an extensive metaplasia to cartilage and bone in the synovial hypertrophy of the capsule. In the toxic cases there is evidence of marked proliferation of the villi of the synovia. These overlie the cartilage, erode it, and bring about an ankylosis in consequence. The ankylosis of the atrophic cases is caused by thinning

of articular cartilage with erosion of apposed cartilage. This is often accompanied by change in shape of the articular ends of bone and subluxation of one upon the other. In all three processes the objective signs are what one would naturally expect from the nature of the underlying pathology. A part of the modern examination of an arthritic joint is its X-ray study. If other parts of the systematic examination reveal clinical differences in the types, there are certainly differences of a pathologic character shown by a comparison of radiographic appearances. In the early stages of the toxic lesions there are no osseous changes to be seen. Later on there are destructive and proliferative changes in cartilage going on side by side. There is a certain amount of rarefication of bone and there will always be much soft part thickening. In the atrophic type rarefication is very marked in advanced cases. The spaces between the ends of bone narrow very much as the cartilage atrophies and in some patients there will be a fusion of the bones when cartilage has become extensively eroded. The metabolic (hypertrophic) lesions are very characteristic, consisting of bone proliferation at the marginal cartilage in whatever joint the lesions are observed. In the terminal phalanges of the fingers where the joints are small and proliferative changes are marked, the picture is not as clear cut as it is in the knee or the hip, but is of the same general character.

One rarely has opportunity for diagnostic purposes to resort to operative exploration of a non-tuberculous joint, but such observations as one does have occasion to make all tend to indicate that the gross and microscopic changes of the three clinical types referred to above are as distinct as the clinical phenomena, provided that one bear in mind this one fact, viz: that terminal pathology must not be confused with early pathology. From the standpoint of physiologic chemistry it has been shown that there is a retention of sulphur in the metabolic type and a loss of calcium in the atrophic type. Sulphur is one of the chief ingredients of cartilage, and proliferated cartilage is the pathologic characteristic of the metabolic (hypertrophic) variety of arthritis. Loss of density in bone and diminution in the size of bone beams is observed in the nutritional (atrophic) type. It is, of course, not practicable to submit these patients for diagnostic purposes to this sort of investigation as a routine, but that is what McCrudden's studies on cases of these types showed.

Many arthritic patients are not easy of classification. This fact in itself should make all the more imperative the necessity for refining our diagnostic procedures. Twenty years ago most practitioners did not take the trouble to make a physical examination. Rheumatism was a suf-

ficiently good diagnosis to make, whatever the type, for treatment was always the same. The result of twenty or more years of study has demonstrated that there are at least three varieties of arthritis and no two of them can be properly managed on the same plan. If etiology, family and personal history, clinical course, pathology (gross or microscopic if possible), and physical signs are carefully studied it is very rare indeed that one should be in doubt as to what type a given case belongs. When the diagnostic goal has been achieved treatment may certainly be more rationally instituted. This, of course, does not mean that a cure will surely be effected, but it does mean that a nearer approach to this desirable end may be brought about than would be by other and less rational means.

POTT'S DISEASE

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In all cases of spondylitis we combine with the sun-cure immobilization in the horizontal position, which is maintained until complete cure of the diseased vertebrae is demonstrated by the roentgenogram, i.e., recalcification of the diseased area, reconstruction of the bone structure, with block formation, etc.

We regard the immobilization in the horizontal position as indispensable. Not only does it give the necessary repose to the spinal column, but, by removing the harmful influence of the body-load, it does away with the tendency to further ulceration due to compression or deviation of the vertebrae. We therefore, on principle, refuse to consider any kind of ambulatory treatment.

To obtain the desirable hyperextension of the diseased segment, we immobilize the patient by turn in the dorsal and the ventral position.

Dorsal Position. Patients suffering from spondylitis, if they have well-developed musculature and no deformity of the spinal column, are immediately placed on the hard mattress, which we always use without the addition of cushions. If the patient, as is unfortunately too often the case, arrives in a condition of extreme emaciation and muscular atrophy, it is necessary to interpose a row of cushions between the body and the mattress. The cushions, filled with millet-seed, used for this purpose, must be of uniform consistency.

A ring cushion supports the pelvis, with the sacral and coccygeal regions resting in the opening, so that the weight which would otherwise be borne by the sacrum alone is transferred to the thighs and buttocks. A second cushion fills the gap formed by the normal lumbo-sacral lordosis, while a third supports the patient's head, neck, and shoulders.

For children and restless adult patients, we use in addition a canvas waistcoat, fastened with straps to the end of the bed. To prevent the patient sitting up or turning in bed, his body is fixed by straps running over the shoulders.

The canvas waistcoat is spread out on the cushions, fixed in position, and the patient buckled into it. Thus we obtain unbroken contact of the

FIG. 1a
A case of Pott's Disease, with marked curvature.

FIG. 1b
Cured after 18 months of heliotherapy.

whole spinal column with the "cushion splint," thereby ensuring an ideal fixation.

Should it be necessary to fix the legs, this can easily be done by double loops over the knees and ankles, attached to the straps running to the bed-end. For irradiation of the ventral surface of the body, one needs only to open the waistcoat.

FIG. 2a

Pott's Disease, with marked curvature and paralysis.

FIG. 2b

The same case, cured after 15 months.

In spondylitis complicated by the formation of a gibbus the diseased segment of the spine is put into hyperextension and we attempt to reduce the gibbus by the slowly increased pressure of the body-weight alone. To attain this we introduce underneath the kyphosis a millet-seed cushion, to be replaced later by a sand cushion, the thickness of which is gradually increased. The cushions must be of equal consistency, so that the spine is firmly supported and maintained in position throughout its length. In

this way is avoided the lateral pressure on the gibbus, with consequent formation of a scoliosis. As soon as the gibbus has been reduced and flattened out and the overlying skin has become less sensitive, the cushion can, with advantage, be replaced by a wooden plank 2 to 3 cm. thick, with slightly convex upper surface, i.e., the contact surfaces with the body slope away toward the head and feet. The plank should extend from one side

FIG. 2e

The same girl, 12 years later; one of our best sportswomen.

of the body to the other, i.e., a width of 15 to 30 cm. Where a thicker plank is necessary we use a block of wood adapted to the gibbus, with holes bored through the surface and sides to permit the air to come into contact with the back. This block of wood presents, as against cushions, the great advantage of permanent form, persistent dryness, and perfect smoothness: indispensable qualities, which obviate the otherwise almost inevitable lying on a damp and wrinkled surface. Patients grow quickly accustomed to the hard surface and prefer it to cushions of sand or millet-seed.

VENTRAL POSITION. When the pain has disappeared, usually after some weeks' sun-treatment, patients are trained to the ventral position. This position favors a suitable lordosis, assures a sufficient repose for the spine, and removes almost completely the body-weight pressure. There need be no fear whatever of spinal fracture in the ventral position. It permits the irradiation of the whole back and in particular of the diseased segments.

FIG. 3a
A case of dorsal superior Pott's Disease. Very bad general health.

FIG 3b
The same child, cured after 16 months.

The procedure is as follows:—

The patient is carefully turned, and after removal of all cushions or wooden blocks, a wedge-shaped cushion is inserted under the chest. By increase in the width of this wedge-shaped cushion one attains and increases at will a lordosis of the spine. By this procedure one can correct a prominent gibbus in the lumbar and dorsal regions and avoid it almost always in the early stages of spondylitis, A patient left in the ventral position has a natural tendency to lift the head to look around and to use

FIG. 4a

Dorsal Pott's Disease and peritonitis; also tuberculous arthritis of the knee-joint.

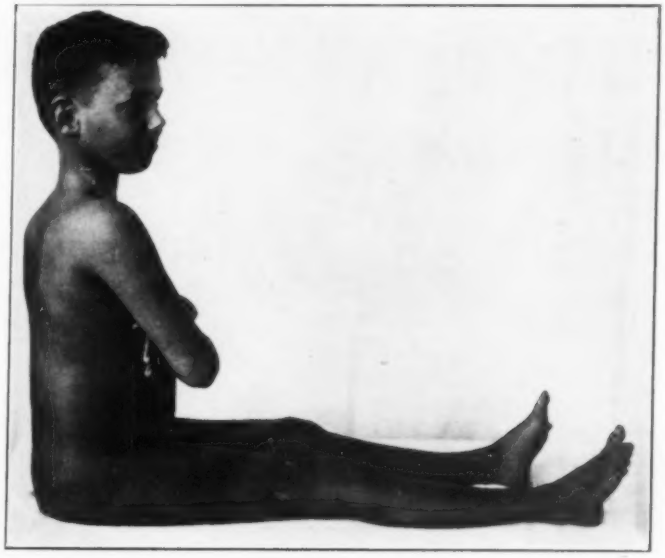

FIG. 4b

Completely cured after 15 months' sun-treatment.

his hands more easily. Thus he gradually brings the spine back into position. This is, in our opinion, the most natural and rational method of correction, for it at the same time exercises the muscles and ligaments

FIG. 4c
The same boy, 10 years after his cure.

of the back in opposition to the ordinary orthopaedic methods, which are generally most harmful to both these systems, so important for a good stance.

These movements are in no way dangerous to the patient, as in the ventral position the vertebrae are relieved of the body-weight. Thanks

FIG. 5a
A case of Pott's Disease, with marked curvature.

FIG. 5b
The same, cured after 18 months.

to this procedure the back-musculature develops to a striking extent and forms a natural corset.

In certain cases, to enable the patient to maintain a sufficient lordosis, we fix to the shoulders straps, which cross one another in their course and are then fastened to the foot of the bed. Through progressive tightening of these straps, the shoulders are pulled back and the development of the thorax favored. Finally, the ventral position is ideal from the physiologi-

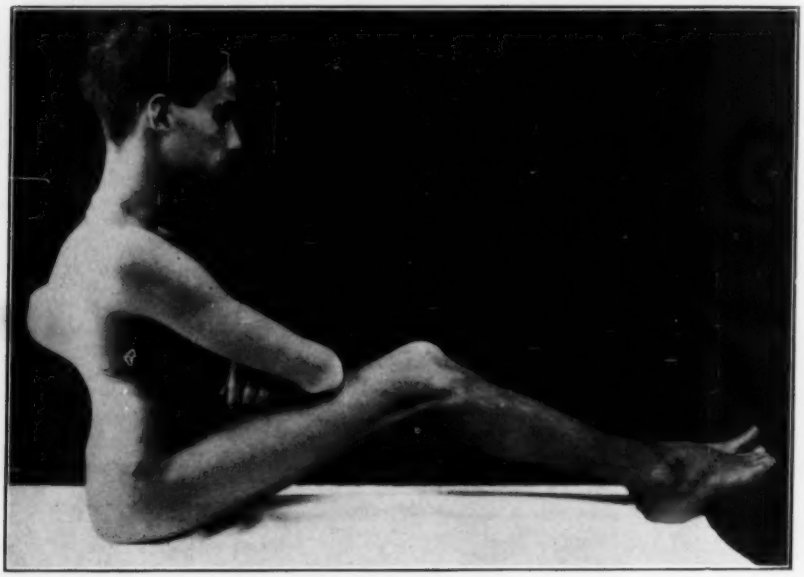

FIG. 6a
Pott's Disease with kyphosis.

cal point of view, for the pressure exercised thereby on the abdomen contributes largely to a regular functioning of the intestines. Further, the patients after a few days prefer this position and remain in it not only for the greater part of the day, but even during the night. The fact that it enables them to enjoy all kinds of occupations, such as stitching, writing, drawing, woodcarving, etc., is not the least of its attractions.

For cervical spondylitis we used at first, together with immobilization, extension by means of a "Glisson's sling." This apparatus may, however, produce in children a marked atrophy of the chin region by the pressure

exerted on the lower jaw. Lately we have avoided this by an apparatus taking its *point d'appui* in the occipital region. A celluloid cup, modelled on a plaster cast of the back of the head, receives the head, which is held fast therein by its own weight. This cup is fitted with wheeled supports, running freely on rails. This eliminates friction and enables any degree of extension. The pull is chiefly on the occipital promontories in the

FIG. 6b

Cured after 23 months; correction of the kyphosis.

horizontal direction, and is transferred to an extension pulley at the head of the bed. Should one desire a counter-extension by body-weight, this is easily obtained by tilting the bed-frame, which is fixed to the bed-ends with hooks.

Patients with closed spondylitis may expect, without exception, a certain cure by our treatment, but the prognosis in cases with mixed infections is much more unfavorable. Since, in spite of all precautions, such complications are frequent after operations or aspiration faultily carried out, we are strongly against all unnecessary surgical interference.

FIG. 7

Solarium at "Les Frênes." (In the foreground several cases of Pott's Disease in ventral position.)

FIG. 8

Balcony for sun cure in one of Dr. Rollier's clinics for children. (Notice also the cases of Pott's Disease in ventral position.)

FIG. 9
Sun-cure and work-cure in Dr. Rollier's Clinics.

FIG. 10
A case of Pott's Disease in dorsal position.

Supporting Apparatus. Heliotherapy, combined with immobilization in the horizontal position, is to be continued until a roentgenogram confirming the clinical findings establishes the radical cure of the diseased area.

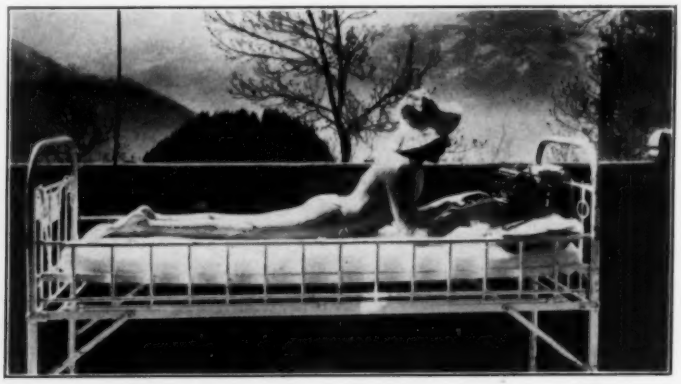

Fig. 11
A patient with Pott's Disease, typewriting.

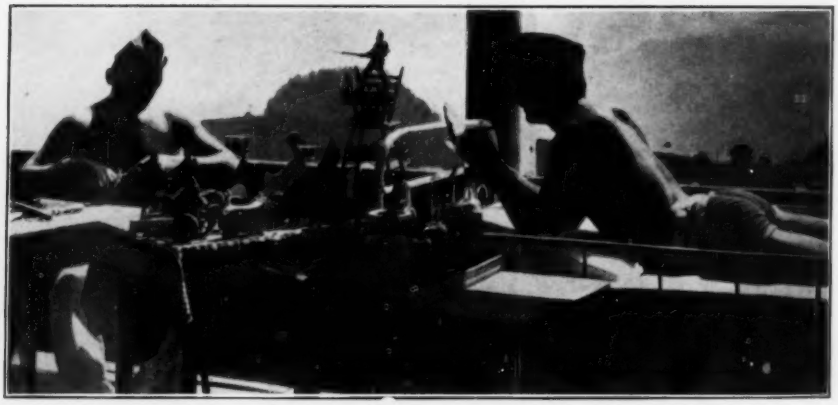

Fig. 12
Another patient with Pott's Disease, toy-making.

If the disease involves more than one vertebra, then we must wait until the roentgenogram shows the formation of a solid cicatricial block with strong bony structure which will prevent subsequent collapse of the vertebrae. This result is obtained generally in from one to two years from

the beginning of the cure, at the time when the chest and dorsal musculatures have been developed to such an extent, under the influence of the sun, as to provide an ideal support for the spine.

When the roentgenogram confirms the clinical findings (i.e., complete disappearance of pain, whether on pressure or by tapping in the long axis; normal reflexes, etc.), one can proceed to get the patient up. To obviate the danger of a fall and to prevent excessive fatigue in the early stages, we use a supporting corset. This may be of different material in accordance with the extent and seriousness of the diseased area.

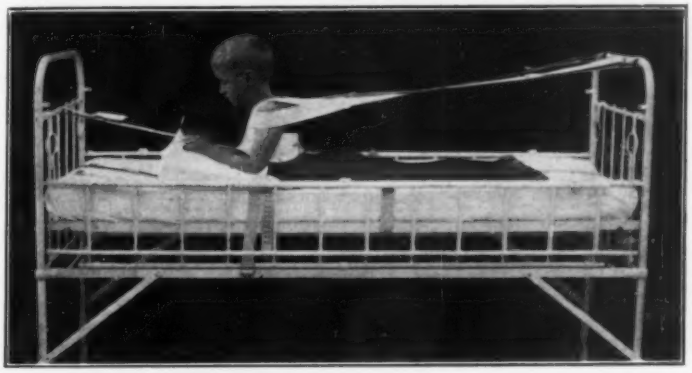

FIG. 13
A young boy with Pott's Disease in ventral position.

As determined opponents of plaster apparatus, we use corsets of celluloid freely perforated, or of linen reinforced with steel rods and with supports for the shoulders. The first are suitable to well-developed males, the second for women or young girls. Grown men wear the celluloid corset for six months and it is then replaced by a lighter one without metal reinforcements, which is worn for another six months. All these corsets are prepared from plaster casts, which must be exactly adapted to the thorax and which are supported from the pelvic rim.

When the cure is complete, the patient cannot be too strongly advised to continue his sun-baths, as far as possible, at home. Nothing else can give him the same guarantee against recurrence.

THE INFECTIVE ARTHRITIDES*

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At a recent meeting of a group of orthopaedic surgeons the question of the chronic infective arthritides was discussed. One of those assembled declared that such discussion was irrelevant for those who had adopted this surgical specialty as their own and suggested that it would be of much greater interest to those who devote themselves to the study of medicine as distinct from surgery.

This statement is open to argument for several reasons. First, orthopaedic surgery is more than an art, and if one is to be a diagnostician, one must possess a very definite knowledge of the most common forms of chronic arthritis. Secondly, if orthopaedic surgery is a branch of science, surely those who devote their lives to the practice of it must be intensely interested in the etiology of a condition which has baffled us all. Lastly, the study of the infective arthritides is one of surpassing importance. A disease which is evidenced in so many and varied forms, a disease which has defied the united efforts of both science and art, ought to claim the consideration of all of those who have chosen the healing of the sick as their vocation.

While there are some who suggest that the etiology of certain of the various forms of the chronic arthritides—and we speak without particular reference to gout—may be of a chemical nature, it is felt by most of us that the greatest number, if not all of these forms, are definitely due to an invasion by micro-organisms or their products.

Most students think that the majority of these conditions are due to a secondary infection, and for this reason the realms of the dentist, the laryngologist, the otologist, the gynaecologist, and the genito-urinary surgeon have been searched for a primary focus. The physician has been called to give his aid. Foci have been eliminated, often without any apparent result.

Those who have studied the infective arthritides know that in many of these cases there is decreased tolerance for sugar, that there is decreased

* From the Montreal Unit, Shriners Hospitals for Crippled Children, December, 1925.

calcium in the blood, that there seems to be a diminished leucocyte response and not a leucocytosis, as is seen in so many infections. If the arthritides are due to bacteria, we know that there must be a poor specific anti-body response in the generality of these conditions; thus treatment by vaccines often seems to be indicated.

The work of many observers has demonstrated that the elimination of discoverable foci of infection often fails to influence the arthritis. This leads us to ask whether it is not likely that in many of these patients the portal of entry of the infective organism or its toxins may be undiscoverable under our present knowledge. If this be so, we must endeavor to learn more of the etiology by studying the characteristics and the history of this condition, although we have already pointed out that it manifests all the characteristics of a chronic infection.

Our search for a clue as to the etiology of the chronic arthritides points to the intestinal tract because the chronic arthritides are sometimes accompanied by disturbed function in some of the endocrinous glands, which disturbance may be due—as from experiments we know it frequently is—to altered intestinal metabolism. And yet, conversely, it is possible that disturbance of the endocrinous glands may be reflected in the intestine, because we would accentuate the observance of the repeated coincident lesions in the intestinal mucosa in cases where the endocrinous glands are affected.

Continuing our study of the characteristics of these conditions, we notice that many of them are influenced by diet, and that the majority of them are much improved by thorough and efficient lavage of the large intestine. It is also on record that certain surgeons have succeeded in staying the course of the worst of the symptoms by excising the colon.

May we not say that both theory and practice draw our attention to the intestinal tract as the probable source or portal of infection in the majority of patients suffering from this disease.

We like to quote from the words of MacCallum[1] in discussing the possibility of the intestine being the portal of entry of this condition. "The intestinal mucosa," he says, "is constantly exposed to the action of products of bacterial fermentation, and when these are toxic, the epithelial cells are the first to experience this action." We would commend to our readers the most fascinating address of this author, who seems to be convinced that the greatest advance in medicine in the next three decades will be based on the results of investigations of the bio-chemistry of the intestinal mucosa, which he regards as the great gateway to disease of the body.

If, then, the intestinal mucosa may be the portal of entry of any dis-

ease, — and we know it is, — how likely is it to be the gateway to such infections as cause the chronic arthritides?

Is there an orthopaedic surgeon who has not seen those most discouraging forms of infective arthritis where both art and science have been powerless to aid, while joints were being destroyed and functions lost? Yet we cannot hope to improve our methods of treatment until we can isolate the infective agent or at least identify it.

Might we not find what organism is affecting a patient without actually finding a focus of infection? If we could succeed in doing this, we could perhaps stimulate the formation of specific anti-bodies by vaccines and neutralize the toxins which may be responsible for the arthritis, and by the formation of bacteriolysines and closely allied bodies assist in destroying the causal organism. If it were possible by a serological examination to learn what organism is responsible for the patient's lesion our goal would be in sight. In secondary and tertiary syphilis we do not need to isolate the protozoa in order to diagnose these conditions, but by the use of the Wassermann reaction we are able to say with some certainty when syphilis exists.

To those most interested in the practical treatment of the chronic forms of arthritis we would recommend a visit to the Clinic of Snyder in the New York Hospital for the Relief of the Ruptured and Crippled. To those who would study the etiology of these conditions and their scientific aspect we would bring to mind the work of Hastings in 1913, and of Swift, Thro, Richards, and others of later date. Of the most interesting recent literature is the work of Burbank and Hadjopoulos,[2] who have developed a technique for the application of the deviation of the complement when using streptococcus antigen. This gives results which, in their hands, are apparently most encouraging. Their investigations have convinced them that not only do streptococci play an important rôle in the arthritides, but that special streptococci are the important factors in special types of the disease.

Let us hope that the research work of the future will be at least guided and stimulated by orthopaedic surgeons who, because of their special training and their duties in the operating room, must of necessity leave the details of such investigations in the hands of those more fitted to achieve the desired results.

REFERENCES

1. MacCallum: Journal of the Canadian Medical Association, April, 1922.
2. Burbank and Hadjopoulos: Journal of the American Medical Association, Feb. 28, 1925.

SPONTANEOUS FRACTURE FOLLOWING BONE BANDING FOR FRACTURES*

BY CHARLES C. GARR, M.D., F.A.C.S., LEXINGTON, KY.

The open reduction of fractures and fixation by bone suture or bone ligature is a very old procedure. Silver, copper, bronze, and gold wire have been advocated for both purposes, as have the absorbable materials, chromic catgut and kangaroo tendon. Metal ligatures not having been entirely satisfactory, the bone band was developed.

Mr. Robert Milne[1] in 1913 showed his invention for applying his metal band at the John B. Murphy Clinic. Parham[2] and Putti[3] about the same time and independently developed a band with instrument for easy and ready application.

Asa W. Collins[4, 5] in 1920 brought out a new band. He says, "A single band around a bone does not possess a sufficient amount of strength to immobilize the fragments, and the slightest lateral motion is enough to cause an erosion and necrosis of bone beneath the band."

I have reviewed a great deal of literature published in the past ten years and find many articles laudatory of bone banding, and very little mention of the fact that the use of constricting bands is not without serious danger in the late results.

F. B. Lund[6] has used the Parham band rather extensively and he reports no bad results. He shows a roentgenogram two years after application of the band for fracture in a child four years of age. In this case the band was entirely enveloped in callus.

Parham,[2] in his original article, discusses the band from a mechanical standpoint and does not discuss the effect on callus.

Mr. Milne[1] deduced from the fact that one of his cases showed the band imbedded in the bone eight months after application that no pressure atrophy occurred.

Ryerson[7] in a discussion of open fracture reduction says, "Cases which actually need operation can be quickly and accurately fastened by one or two metal bands of the Parham or Collins variety. These bands do not interfere with bone formation or bone growth."

*Read before the C. & O. Railroad Surgeons' Association, White Sulphur Springs, West Virginia. November 5, 1925.

Cotton and Duff[8] have devised a wiring instrument to avoid disadvantages of the bone band. They think the band, though imbedded, creates a point of least resistance and they report a case of fracture at the band site after a slight accident.

Scudder[9] is the only author I know who believes that the band should routinely be removed.

I believe that cases of spontaneous fracture following a banding operation are more numerous than an analysis of the literature would have us believe. Personally I have never applied a band without removing it within one month.

I wish to report two cases in which the bands had been very properly and neatly applied by competent men and which fell into my hands for spontaneous fracture due only to muscular action.

The first patient, a man 23 years of age, whom I first saw on May 20, 1923, had had a serious fall on December 12, 1922, which resulted in a subtrochanteric fracture of the left femur. He had open reduction in Florida with application of two bands, and was in a plaster spica from the nipple line to and including the left foot. He left the hospital in Florida on April 29, 1923, on crutches, and came to Kentucky, but complained of pain at times in the upper third of the left thigh. This pain had become worse and more constant after May 10, and on May 19, while walking with a cane, he had great pain and heard a snapping noise in his leg, which gave way and he fell to the ground. The roentgenograms showed the rarefaction that had taken place and the transverse break without displacement (Case 1, Fig. 1). The bands were removed with considerable difficulty, as they were imbedded in the callus, and the leg was fixed in a plaster spica as in a fractured hip (Case 1, Fig. 2). He was kept in plaster for four months, with the result that the bone finally united with some bowing and with one inch shortening (Case 1, Fig. 4). The Wassermann examination was negative and the general health was normal in every respect.

The second patient was a man 52 years of age who had fallen on a hotel floor in Cincinnati in October, 1924. An open reduction was done for an intercondylar fracture of the right femur, with displacement upward of the internal condyle. An attempt was made by his surgeon to hold the fragment in place by means of a beef-bone screw, but as the fracture seemed insecure after two screws had been introduced, he encircled a Collins bone band. The patient was treated in a plaster cast until the latter part of December, when he was allowed to return home on crutches.

I saw him first on January 1, 1925, with complaint of pain in the

CASE 1. FIG. 1. May 20, 1923.
Spontaneous fracture five months after application of bands.

CASE 1. FIG. 2. May 28, 1923.
In plaster-of-Paris spica.

CASE 1. FIG. 3. August 17, 1923.
Showing defect due to bone necrosis.

CASE 1. FIG. 4. October 30, 1923.

lower fourth of the right femur. He was a large man weighing two hundred pounds. Fifteen years previously he had had an apoplectic stroke, which had resulted in a marked reduction of muscle power in the entire left leg, as well as considerable atrophy. The union in the right femur seemed firm, and he could flex the leg to 90 degrees without pain. The patella was freely movable and the joint was not swollen. Pressure over the lower fourth of the femur caused pain.

CASE 2. FIG. 1. January 1, 1925

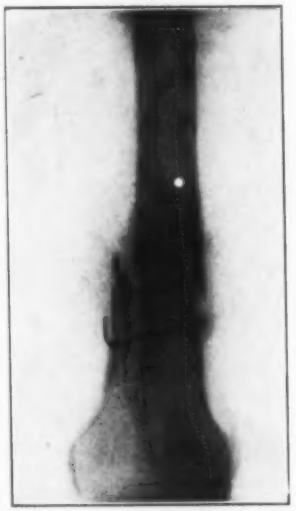
Antero-posterior view of Collins' band *in situ*, showing rarefaction from pressure.

CASE 2. FIG. 2.

Same as Fig. 1 in lateral view.

The general examination was negative for pathology. Wassermann and urine examinations were negative. The roentgenograms showed the bone band and bone screw in position, but the bone showed increased rarefaction, and operation for removal of the band was advised (Case 2, Figs. 1 and 2). The pain became worse until January 10, when the band and screw were removed, but with difficulty. Examination of the bone itself at the time of operation indicated that the union was firm. After a stay of two weeks in the hospital he returned home and was permitted to walk with crutches.

On January 27 he had severe pain in the region of the fracture and



CASE 2. FIG. 3. January 28, 1925.

Spontaneous fracture of femur three months following application of band and two weeks following removal of bands (a part of band was unintentionally left at operation).

CASE 2. FIG. 4. March 12, 1925

CASE 2. FIG. 5. June 15, 1925.

Union firm. Necrotic bone has been absorbed, resulting in one inch shortening.

the following day, while lifting his leg in taking a step with crutches, he heard a snapping noise and felt great pain above the right knee. The roentgenogram disclosed a transverse break through the rarefaction that had been observed in the first picture (Case 2, Fig. 3).

The subsequent treatment consisted of fixation of the leg in plaster, followed by a Thomas splint. The incision broke down and discharged a small amount of a serous material which produced no growth on culture. Union was very slow, and I believe a certain amount of devitalized bone had to be absorbed or discharged through the incision before callus could be formed (Case 2, Fig. 4).

On July 1, 1925, he stood with crutches for the first time. A roentgenogram, as well as examination of the leg, showed firm union (Case 2, Fig. 5). Measurement showed the right leg one inch shorter than the left.

In this case it was of prime importance to secure union on account of the semi-paralyzed left leg.

The band was originated for spiral fractures and it holds them in position admirably, but it is my opinion when it is used it should always be removed within a month, for by that time simple fixation will be sufficient and the nutrition of the bone will not be seriously impaired.

REFERENCES

1. Milne: Murphy Clinics, April, 1913.
2. Parham: Surg., Gyn., and Obst., Vol. XXIII, 1916, page 541.
3. Putti: La Clinica Chirurgica, Vol. XXII, June 30, 1914.
4. Collins: Jour. A. M. A., Vol. LXXIV, page 951.
5. Collins: Surg., Gyn., and Obst., Vol. XXIX, page 513.
6. Lund: Surg., Gyn., and Obst., Vol. XXIII, 1916, page 545.
7. Ryerson: Southern Medical Jour., Vol. XV, page 475.
8. Cotton and Duff: Surg., Gyn., and Obst., Vol. XXV, page 557.
9. Scudder: Textbook on Fractures, Ninth Edition.

TENDON TRANSPLANTATIONS FOR DIVISION OF THE EXTENSOR TENDON OF THE FINGERS

BY LEO MAYER, M.D., NEW YORK CITY

Although injuries to the extensor tendons of the fingers are comparatively less frequent than those to the flexors, they are to be classed as among the more common tendon traumata. In uninfected cases of division of the extensor tendons, their immediate suture can be performed with excellent prospect of perfect return of function. When, however, the tendon wound is complicated by infection or by extensive injury to the surrounding tissues, as in the case of burns, then the problem is not so simple. The tendon-ends then usually retract a distance of one or more inches and the tissue between develops into a dense scar to which the bone is often adherent. When the lesion is in the finger itself these adverse conditions lower the percentage of good operative results to such an extent as to make one skeptical about the advisability of operating at all. If, however, the lesion is in the hand itself, then despite these adverse conditions a high percentage of cures can be accomplished. The method which I have used has for its basis the fortunate anatomic fact that the index finger is supplied not with one extensor tendon, but with two: the extensor indicis and a branch of the extensor communis digitorum. It is possible to sacrifice one of these tendons and at the same time retain sufficient strength in the index finger to meet all practical needs. The operation consists in the transference of the more superficial of these extensor tendons, namely, that of the extensor communis digitorum, to replace the injured extensor tendon. If the lesion has occurred to the index finger tendons themselves, then this method is not applicable. It can, however, be used for injuries to the thumb, middle, fourth, or fifth fingers.

In performing the operation, local anaesthesia is preferable. A one and a half inch curving incision is made at the base of the metacarpophalangeal joint, exposing the distal end of the divided extensor tendon. The incision is placed in such a way that it will not lie over the site of the tendon splicing. For instance, if the tendon of the middle finger has been injured (see Figs. 1 and 2) the incision is placed to the ulnar side of the third metacarpal bone; if the extensor tendon of the thumb has

FIG. 1

Shows the skin incisions in a case of division of the extensor tendon of the middle finger.

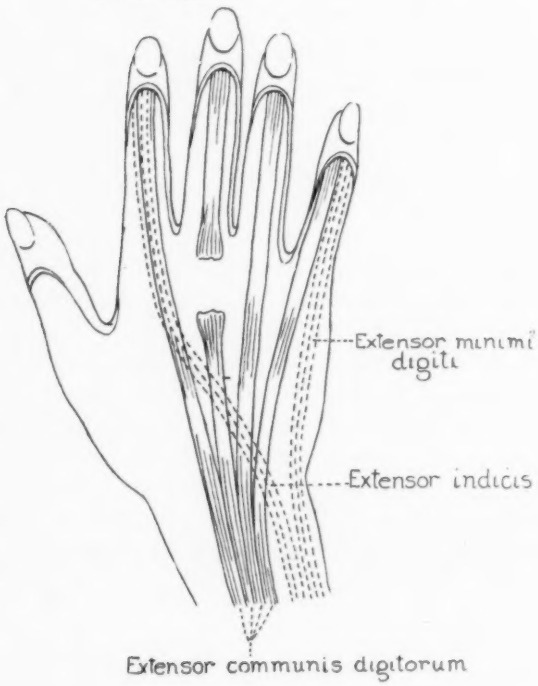


FIG. 2

Diagrammatic sketch illustrating the pathologic conditions found in non-union after division of the extensor tendon of the middle finger.

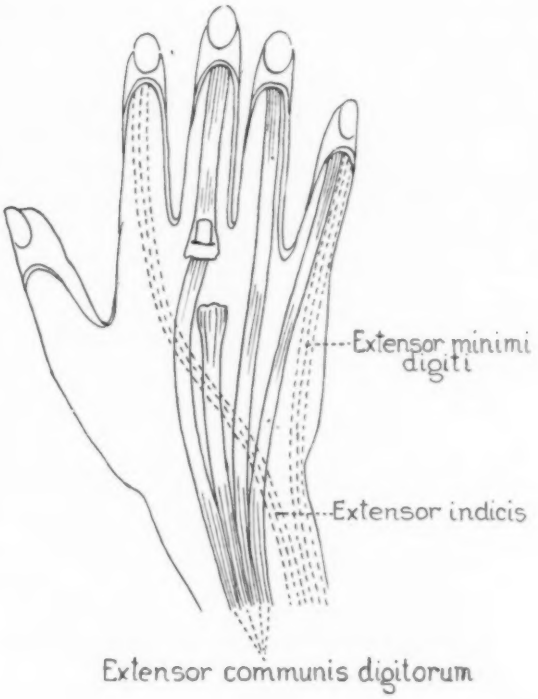


FIG. 3

Diagram to illustrate the method of transferring the index finger tendon of the extensor communis digitorum to replace the divided extensor of the middle finger.

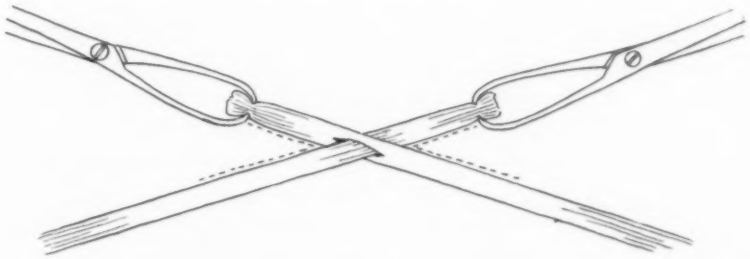


FIG. 4

Illustrates the buttonhole method of tendon suture. The dotted lines show the surfaces of the tendon which are brought into apposition. Here the gliding cells must be thoroughly scraped away.

been injured it is placed to the radial side of the first metacarpal bone. The tendon stump is identified, it is freed from all adhesions, the free end is grasped at its tip by a tendon clamp, and traction is made on the tendon to be sure that its extensor effect on the finger is not in any way interfered with. Frequently by this procedure small adhesions are torn or more massive ones are demonstrated, which can be divided with the knife. A second incision about three inches long is made in the course of the extensor tendons of the index finger running from the metacarpo-phalangeal joint upward towards the wrist. The two tendons are

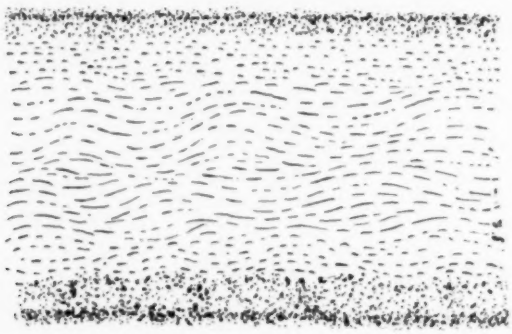


FIG. 5

Semi-diagrammatic drawing of a longitudinal section through an adult tendon to illustrate the microscopical difference between the superficial and the deep cells of the tendon. The superficial gliding cells with the rounded nuclei must be scraped away, exposing the deeper tendon cells with the elongated nuclei.

readily identified and with a little practice it is easy to separate the superficial from the deep. The superficial, it will be remembered, is a portion of the extensor communis digitorum (see Fig. 2). It is severed at the metacarpo-phalangeal joint and lifted away from the deeper tendon. In doing this the peritenon which surrounds the tendon should be traumatized as little as possible. The tendon is freed a sufficient distance so that its line of traction when transplanted to the injured finger will be as nearly as possible in a straight line (Fig. 3). A subcutaneous channel is bored from the first incision toward the wrist in the direction of the extensor communis digitorum tendon. This channel must be sufficiently wide so that the transplanted tendon will not be in any way

impeded. It is drawn downward through this channel, and if the procedure has been properly done it will be found that the replacing index finger tendon and the stump of the divided tendon overlap a distance of about one-half inch. We are now ready to perform the actual tendon splicing. This may be done by the end-to-end method, but I have found that there is more security in using the buttonhole, overlapping method.

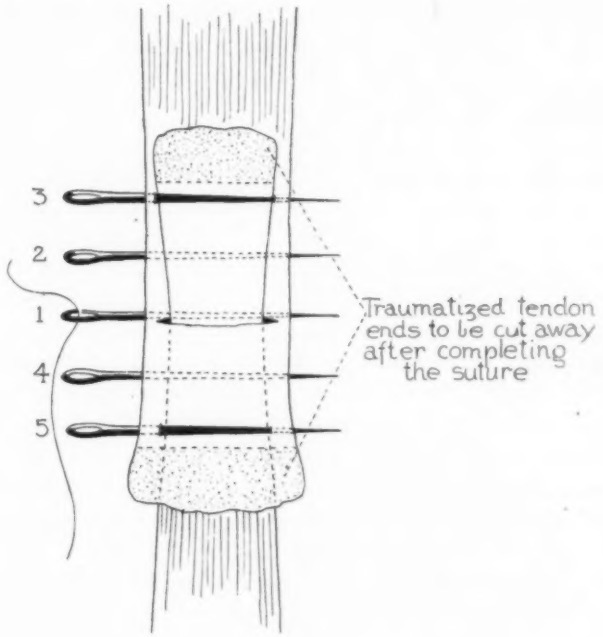


FIG. 6

Illustrates the method of passing the silk sutures in the buttonhole method of tendon splicing. Note that the two end stitches are placed in such a way as to bury the tendon stumps. The dotted areas indicate the traumatized tendon ends which are bevelled off at an acute angle.

In this procedure the stump of the injured tendon is perforated in its mid-line one-half inch from the free end with a sharp scalpel. Through this little slit the replacing tendon is drawn. The two tendons are grasped securely with tendon clamps (Fig. 4) and are drawn sufficiently tight so that with the muscle contracted the finger is held fully extended. To determine the tension accurately it is advisable to have the patient actively contract the extensor communis digitorum. This can, of course,

be done only if a local anaesthesia is used. Next the surfaces of the tendon which come in apposition with one another must be scraped so as to remove the gliding cells which coat these surfaces (Fig. 4). This step of the operation I consider very important since firm union between the tendons will not occur unless the deeper layers of the tendon are brought into intimate contact. It would be well for every operator to view the longitudinal section of a tendon microscopically (Fig. 5). He would see that the superficial cells of the tendon are quite different from the deeper layers. The nuclei of the true tendon cells are elongated; the cells themselves are quite long, narrow structures. Those near the surface, however, contain small round nuclei, the cells are much shortened, and they stain somewhat differently. In certain tendons, particularly where pressure occurs between the tendon and bone, they assume the characteristics of cartilage cells, and frequently sesamoid bone will develop. These superficial cells are evidently intended to preserve the gliding function of the tendon, and unless they are removed the union after the tendon suture will not be sufficiently stable to permit early, active motion.

Following the removal of the gliding cells five interrupted sutures are passed through the two tendons, the first directly at the point of crossing, then two on each side of the first. The best material is braided silk; the needle I prefer is a fine straight cambric needle with a calyx eye. In taking the distal and proximal stitches the operator should endeavor to place the stitch in such a way as to leave as little tendon as possible projecting. This is done partly by bevelling the tendon ends, partly by burying one tendon inside of the other (see Fig. 6). The tendon ends are bevelled with a sharp knife at an oblique angle. This step removes the traumatized tendon ends and facilitates an accurate splicing. The operation is completed by drawing together the superficial fascia over the tendon suture with fine gut stitches. The small skin incision is closed with interrupted sutures, the larger with a continuous stitch.

The post-operative treatment is very important. The finger should be kept immobilized in the extended position for eight days, then active motion should be begun, very gently at first, and always replacing the finger on the splint to keep it extended. Gradually the motions are increased both in range and in strength. As a rule, within four weeks after the operation range of motion is about 75 per cent. of the normal; with persistence in the further exercise treatment, conditions can be restored completely to the normal.

If the extensor tendons of two fingers have been injured one can be

replaced by the method already outlined; to replace the other it is sometimes possible to utilize one of the accessory tendons of the extensor communis digitorum. These accessory tendons occur very frequently and are to be considered the rule rather than the exception. In a case to be described below one-half of the extensor tendon of the little finger was utilized to replace the divided extensors of the ring finger. The result here was fully as good as when the index finger tendon was used for the transplant.

ILLUSTRATIVE CASES

Mr. M. F. This patient was injured June 24, 1923, in an automobile accident. In addition to numerous other injuries of the left arm there occurred a complete division of the extensor tendons of the middle and ring fingers. Operation January 6, 1925, under general anaesthesia. One and a half inch incision over the metacarpo-phalangeal joint of the middle finger. The divided extensor tendon was found bound down by dense scar tissue. It was freed from all adhesions. Through a second incision four inches long over the extensor tendons of the index finger, the tendon to be transplanted was exposed, brought through a subcutaneous channel and united to the middle finger tendon by the buttonhole method. A splint was applied to hold the wrist and fingers extended. January 16 the wounds were found firmly healed, the patient was able to extend the finger voluntarily. He was given a course of post-operative exercises. End-result: strong extension of the middle finger; about 75 per cent. of normal power of flexion. Operation on the ring finger is to be done during the next months.

Mr. C. J. May, 1921, suffered extensive electrical burns to both hands. On the right hand the extensor tendons of the middle and ring fingers were completely destroyed. Examination September, 1921, showed a dense scar the size of a fifty-cent piece on the dorsum of the right hand in the region of the third and fourth metacarpal bones. The scar was adherent to the bone and to all the surrounding tissues. It was impossible for the patient to extend the third and fourth fingers; they could be flexed only about 50 per cent. of the normal. First operation October 6, 1921, under local anaesthesia. A two-inch curving incision along the radial side of the metacarpo-phalangeal joint of the middle finger. The extensor tendon was found to be divided near the level of the joint. It was freed for a distance of three-quarters of an inch. A four-inch incision was then made in the course of the extensor tendons of the index finger, the tendon of the extensor communis digitorum was transplanted through a subcutaneous channel and spliced to the middle finger tendon by the buttonhole method. Dressing October 21 showed that a slight sloughing of the wound had occurred, evidently owing to poor nutrition due to the scar. Some of the silk strands holding the tendons together were exposed and these were removed. The skin edges were approximated by means of adhesive plaster strips. Owing to the delayed union no exercises were given. Within a week union of the skin had occurred. On October 31 patient was able to extend the third finger actively. November 4: second operation to replace the divided extensor tendons of the fourth finger. After exposing the divided extensor tendon of the ring finger, one-half of the extensor tendon of the little finger was transplanted subcutaneously and attached by the buttonhole method to the divided extensor. November 10: the wound had to be opened because of swelling; about two ounces of slightly purulent

fluid was withdrawn. The wound remained open until the 30th, when a silk suture was removed and it then closed. Within the next two weeks motion of the finger improved rapidly; the patient was able to extend it to the normal and flex it about 50 per cent. of the normal. By the end of December both the third and fourth fingers had normal extension and almost full power of flexion. (See Figures 7, 8, 9.)

Mr. F. S. January 19, while washing bottles, the left hand was cut by a piece of glass. Examination on February 3 showed an infected wound about one inch long

FIG. 7

Photograph of Mr. C. J. subsequent to the operations for replacing division of the extensor tendons of the middle and ring fingers. Note the dense scar in the region of the third and fourth metacarpal bones caused by the electrical burn.

over the metacarpo-phalangeal joint of the thumb. Patient was unable to extend the thumb. Under treatment the wound healed in ten days' time. Operation was deferred owing to illness of patient until May 26. Then under general anaesthesia the divided extensor tendons of the thumb were exposed by a two-inch L-shaped incision. The extensor communis digitorum tendon of the index finger was exposed through a three-inch incision and transplanted by the usual method. The thumb was immobilized in extension. In this case the wound healed by primary intention and power of extension returned rapidly. It took, however, two and a half months before satisfactory flexion could be secured. (See Figures 10, 11.)

FIG. 8

Patient Mr. C. J. This photograph shows the power of flexion subsequent to operation and treatment.

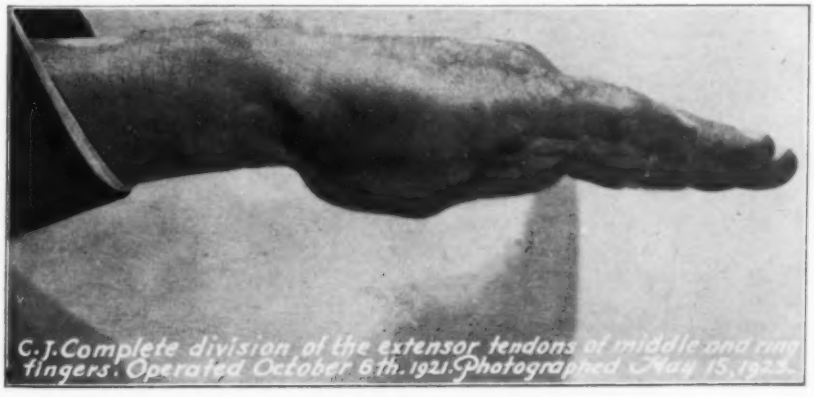

C. J. Complete division of the extensor tendons of middle and ring
fingers. Operated October 6th. 1921. Photographed May 15, 1922.

FIG. 9

Patient Mr. C. J. Side view of the hand, showing power of extension subsequent to tendon transplantations replacing the divided extensor tendons of the third and fourth fingers.

The next case illustrates the necessity for modifying the operative technique when the pathologic conditions found at operation so require.

Miss M. H. was injured May 15, 1924, when the right hand was cut by the blade of an electric boring machine. Since the accident she had been unable to extend the right middle finger. Examination November 5 showed a two and a half inch scar on the dorsum of the right hand extending from the base of the fourth finger obliquely downward toward the middle of the metacarpal bone of the index finger. Patient

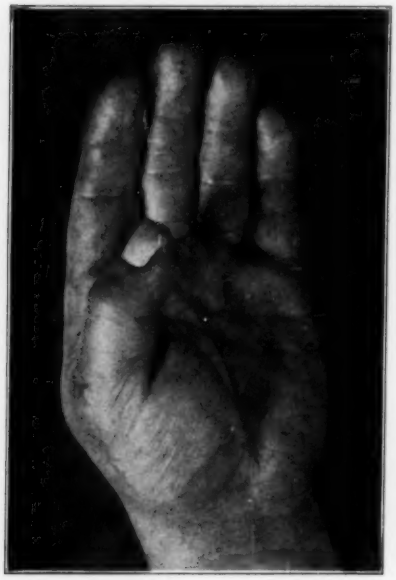


FIG. 10

FIG. 11

Patient Mr. F. S. Photographs illustrating power of flexion and extension of the thumb subsequent to transplantation of the extensor tendon of the index finger for division of the extensor tendons of the thumb.

was unable to extend the middle finger; extension of the index finger was somewhat weaker than normal. At operation, November 19, the injured extensor tendon of the middle finger was exposed by the usual incision, under local anaesthesia. It was then found that there was union between the distal and proximal stumps of the tendon, this union being composed of scar tissue and sufficiently strong to produce slight motion, but not strong enough to give any perceptible extension of the finger. Through a second incision the index finger tendons were exposed. They were found degenerated to such an extent by the formation of scar tissue as to make it impossible to use either for transplantation purposes. Consequently, instead of attempting the usual operation, the scar tissue of the middle finger was excised and the tendon stumps thus freshened were brought together and overlapped about one-half inch by the buttonhole method.

Miss H. Complete division of the extensor
tendons of the middle finger. Injured May 15th. 1924
Operated November 19th. Photographed January 17. 1925

FIG. 12

Miss H. Complete division of the extensor tendons of the middle
finger. Injured May 15th. 1924. — Operated November 19th.
Photographed January 17. 1925

FIG. 13

Patient Miss M. H. These photographs illustrate the power of flexion and extension of the middle finger subsequent to operation.

Three silk sutures were used instead of the usual four or five. Healing of the wound by primary intention. Active exercises were begun after ten days. Patient was discharged with almost perfect motion of the middle finger. (See Figures 12 and 13.)

CONCLUSION

Traumatic division of the extensor tendons in which primary suture of the extensor tendons is contraindicated because of infection or extensive trauma to adjacent tissues can be successfully treated by tendon transplantation performed under suitable operative conditions. The extensor communis digitorum tendon of the index finger is the most suitable for transplantation purposes.

DISINFECTION OF SEPTIC JOINTS

BY F. J. COTTON, M.D., BOSTON, MASS.

Treatment of suppuration *within* a joint by incision and drainage is an outrage. In the war cases, drainage and Dakin treatment, with or without the later Willems treatment of constant motion, was the best thing possible: the results not too bad. In like cases in war or peace simple drainage is utterly inadequate, and yet that is the treatment often carried out. In cases of sepsis without a wound, common enough in civil practice, to drain a joint and let it go to ruin when proper disinfection will give *not relief*, but a *prompt cure* in most cases, is hardly less than malpractice today.

That this thing can be done I showed in a paper read before the Hennepin County (Minnesota) Medical Society June 7, 1915, and published in the Boston Medical and Surgical Journal, Dec. 16, 1915, Vol. clxxiii, p. 905. A second supplementary article appeared in the same journal on June 16, 1916, Vol. clxxiv, p. 779. No one paid any attention.

This disinfection work started with the gonorrheal joints in the main hospital and was developed in the South Department (Contagious) of the City Hospital, Boston, on the septic joints so dreaded in the later course of the exanthemata. After 1915 the work went on, and the cases, not all with records at hand for citation, have reached a decent total, with a high percentage of good results. A number of them were Dr. Edward Place's "South Department" cases.

In 1916 the Lancet, then in the war, with a bit of intelligent interest in septic joints, republished most of the article in an editorial.* From time to time attempts have been made by my colleagues, with more failures than I have had, because they attempted to improve the technique without troubling themselves to learn it: without taking sufficient pains to be thorough, I think.

And that is all save that I have been going on, with an occasional failure in a joint too far gone or one with a communicating bone lesion, but with a comfortable majority of successes.

The following report is of a little group of recent cases that seem to me worthy of serious attention.

*Disinfection of Septic Joints. Editorial: Lancet: April 8, 1916, page 788.

CASE REPORTS

Myra H. Seen evening of September 26, 1921, with Dr. Bradford Kent. Girl of 10 years. No antecedent sepsis. Ill five days with rise of temperature. Obviously infected knee joint; distended; abscess of popliteal space.

September 27, 1921. Operation, as soon as patient reached the hospital. Knee joint opened and irrigated in the routine fashion and then closed. Abscess opened and drained; probable bone focus near epiphyseal line of femur. No definite lesion in bone. Tissue curettings showed granulations. No tuberculosis. Culture from knee showed staphylococcus pyogenes aureus; culture from abscess showed some staphylococcus. So far as the joint sepsis was concerned, patient was well after the first three days of mild reaction. The abscess, of course, drained and closed slowly. Due to this and to a somewhat refractory small patient, the knee function was not fully restored for a couple of months.

December 10, 1921, she had a perfectly functioning knee, and has remained well since then.

George M. Seen with Dr. A. Gardner at the Lowell General Hospital, November 25, 1924. Old osteomyelitis of tibia eight years previously, involving right knee joint, leaving a little limitation of motion and not quite perfect extension.

The patient, a vigorous young man of 25, had worked actively until an accident a week previous had stirred up the old process. The day before my examination the tibia had been opened and the knee joint drained on both sides. The joint was full of pus, but cultures showed no growth. At the time of my examination the joint was full of clot.

Under an anaesthetic the clot was removed, one drainage incision closed, and the routine irrigation and closure carried out. The drainage of the tibial cavity was better ensured by clearing out. Patient showed little reaction. The culture taken at the time of my operation showed again no growth. Closure of the tibial wound was prompt, occurring in about eight weeks. Recovery of knee action was somewhat delayed, but in six months was about what it had been, according to the patient, before the recurrent infection; flexion to 80 degrees, extension about 10 degrees short.

Mary D. Twelve years of age. Seen November 27, 1924. Referred by Dr. John Foley. No antecedent sepsis. Effusion in knee for three weeks without grave symptoms.

At examination knee found to be distended, a bit tender; fluid apparently all in joint but a little swelling about the joint. Some pain, some spasm. Temperature to 101 degrees. Child not obviously ill.

An immediate operation (she was already in the hospital) showed a joint full of pus. The usual technique was carried out, but it was noted several times in the course of the washing that the washings became cloudy in an unexplained way. For fear of a perforation pocket the washing was continued much longer than the usual fifteen minutes. Culture report was returned as streptococcus hemolyticus. For three days the patient seemed all right, then developed a technical scarlet fever and was transferred to the "South" Contagious Department. After a week, there was obvious sepsis in the upper part of the joint.

December 11, 1924, under ether, an incision was made and pus found in the quadriceps bursa and in a communicating abscess cavity above it,—obviously the perforation

pocket guessed at before. Examination showed the quadriceps bursa walled off from the joint proper,—a merciful result of the temporary asepsis.

December 16, 1924. Reopening of a pocket high up. The drainage wound soon healed. There was no trouble from the joint itself and when the patient was last seen, on May 2, 1925, the knee was normal, save for scar, with full function.

Jack S. Age four and one-half. Seen with Dr. Eli Friedman, July 2, 1925. Pseudo-diphtheritic laryngitis with obstruction with prompt recovery five weeks previously. Two weeks later large tonsils, discovered while the patient was in the Contagious Department of the City Hospital, were removed. Apparently uncomplicated recovery, but a week ago the child complained of the right elbow. There was pain and local heat, and when the patient was seen in Dr. Ritvo's X-ray office he was apathetic and obviously very ill. Temperature 103 degrees. Roentgenograms, of course, were negative. The elbow joint was hot, swollen, and the sub-tricipital pouch tensely filled. Some muscle spasm, but (as usual with these septic joints) not in proportion to the severity of the joint process.

The child was taken to the hospital immediately. Under gas ether a tapping of the joint confirmed the diagnosis of pus.

Incision over the outer side of the joint, high up. Opening of the capsule—a thin structure in the elbow—just enough to admit the tip of the irrigator nozzle. 1:15000 corrosive in normal salt for *fifteen minutes by the watch* with final flushing with normal salt.* The usual care was taken as to alternate "ballooning" and emptying and motion of the joint during the process to ensure clearing fibrin from the out-of-the-way corners of the joint; the usual suturing in two layers, water tight; outer wound left open as usual under alcohol dressing.

For three days there was an elevation of temperature,—with 100 degrees as the maximum. There was a little temporary synovial effusion; no sepsis even of outer wound. The outer wound healed and the joint was nearly normal in a week. A month later the joint showed nothing abnormal but the scar.

Culture report: Streptococcus, not hemolytic.

The technique is simple. In a knee one cuts down on the outer side, enters the quadriceps pouch with a small incision and begins to irrigate. The incision is only about one-third inch and a blunt, taper-pointed irrigator nozzle (like that of a urethral syringe) fits into the hole. Only the tip goes in. Under a head of 18 inches more or less, fluid is run in and the joint distended,—"ballooned." The irrigator tip is withdrawn and the joint emptied. This is repeated and the joint fluid presently runs clear. The ballooning and emptying washes well, and the cleansing is helped by flexing and extending the joint, which brings fibrin clots out of distant recesses in the joint. This washing is kept up for fifteen minutes by the clock. The fluid used has been a normal salt solution with 1:15000 corrosive sublimate. The washing once finished, one stitches the synovial

*To guard against mercurial absorption of any possible excess corrosive that might be left in.

capsule (sutures of catgut No. 0 or No. 1, *not* exposed within the joint) and then the fibrous capsule is sewed up with a water tight lock stitch. The shallow outer wound through necessarily infected soft parts is left open and an alcohol dressing is applied. A "pillow splint" is applied: no rigid splints. There is rarely any delay in the healing of this outer wound. There is commonly a reaction with a little joint effusion, sometimes with

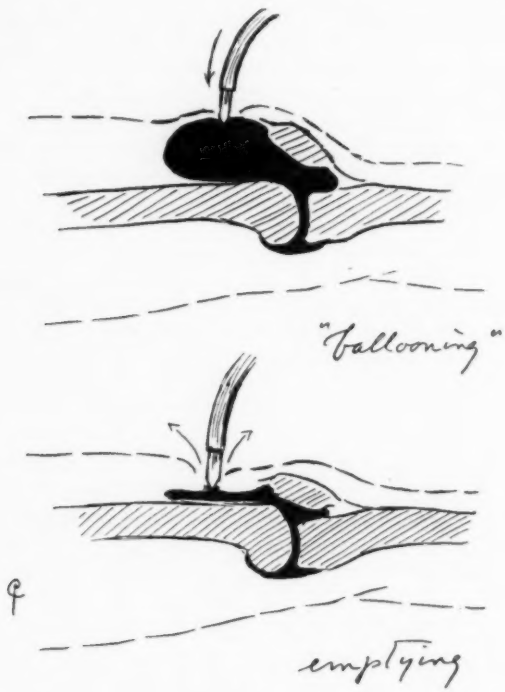


FIG. 1
Technique of irrigation.

a little temperature for two or three days, then the fluid goes away and the joint promptly becomes normal.

Motion is allowed from the tenth day, although an earlier date might be safe. Full recovery of function is prompt,—a nearly normal joint by the time the outer wound is healed, unless there is some complication like an associated osteomyelitic abscess. There have now been a good many of these cases and most of the results have been good.

A focus of infected bone within the joint defeats the disinfection.

Joints already opened *may* still be sterilizable (Case 2) or may not.

How important the corrosive is I can not say, having always used it. Certain cases I have seen in other hands—failures—following irrigations with salt solution, but this may have been a question of mechanical technique or impatience with my fifteen minutes.

One patient,* dying soon of meningitis, furnished Dr. Mallory with a specimen. It proved the condition to be that of a normal joint save for a debatable film on the synovial surface, possibly a coagulum due to the corrosive irrigation.

I am fully aware of the fact that joints may be infected and not be destroyed. In my series are several such.

There are four cases besides the one reported above with pus, showing no growth on culture, which recovered after tapping.

More interesting are two cases with positive cultures.

A baby of fourteen months, from the City Hospital Out-Patient Department, showed a chronic effusion in a knee of not less than six weeks' standing. The child was *not* ill. Tapping showed pus and the joint was emptied. Culture showed staphylococcus pyogenes aureus. The knee got well and stayed well.

A girl of eleven years was on my service two years ago very ill with an osteomyelitis of the right femur and a sepsis of the left hip. I operated on the leg, but dared do no more than tap the hip (getting frank pus) and wait. So far as the hip went there proved to be nothing more than a positive culture from the pus of the hip joint of staphylococcus pyogenes aureus. The leg wound drained and last summer a second operation was performed to clean out a small bit of dead bone, but the hip was normal.

Although it is true that joints are more tolerant than we have thought, and infections burn themselves out at times, nevertheless, sometimes a case occurs such as the following.

A man of 45 with a recent urethral infection, both knees involved, one for five weeks, one for five or six days, showed no improvement under conservative treatment. Both joints were washed out. The fresher joint recovered within a week, the other took four months to be restored to a not quite perfect condition.

As I see it:

Joints are relatively tolerant of infections of various sorts.

So long as the infection is confined to the synovial cavity, the joint is sterilizable.

The operation is not a grave one, and, properly done, can do no harm.

Even in joints with infection and effusion that *might* get well of them-

*Cited in the 1915 paper.

selves, it seems certain that they get well quicker if pus and fibrin are moved.

In the graver cases there can be no argument.

This technique offers, at worst, relief, and a proper chance to institute Dakin treatment and early constant mobilization according to Willems' technique.

At best, and usually, it offers cure instead of ruin, and this method of treatment can hardly be ignored much longer.

NON-SUPPURATIVE OSTEOMYELITIS, WITH REPORT OF AN UNUSUAL CASE

BY MAXWELL HARBIN, M.D., CLEVELAND, OHIO

Associate in Orthopaedic Surgery to Lakeside Hospital

The following is a report of a rather unusual case of non-suppurative sclerosing osteomyelitis of the os calcis. It is of interest particularly because of its involvement of the body of the bone together with the epiphysis. Its behavior is similar to that seen in the long bones, with slightly different changes due to the variation in structure of the tarsals. When considered from the standpoint of the epiphysis, however, the roentgenogram strongly suggests the picture of an epiphysitis with the thickening of the part proximal to it.

An infection of the bone without suppuration is not rare. Cheyne, in 1890, described a case of osteitis in the radius, in which at operation a sequestrum was removed without a trace of pus being encountered. Garré's description appeared in 1893, after which the condition was known as "osteomyelitis of Garré." Trendel in 1904, Kleum in 1912, S. F. Jones in 1921, A. D. Kurtz in 1922, and M. S. Henderson in 1924, have reported cases of the same type, limiting their discussion, however, to disease of the long bones.

Case No. 107857. The patient, a white boy of fourteen years, was admitted to Lakeside Hospital May 18, 1925, complaining of pain in the left heel. His past history was unimportant. He had the usual childhood diseases and was perfectly well until one year ago, when he stepped on a rusty nail which he claims was removed from his left heel in the accident ward. He was given antitetanic serum and a dressing applied. He went home and was in bed for a period of three months because of pain upon weight-bearing. He states there was never any definite redness or suppuration. Since beginning to walk again he has noticed pain in the heel, rather generalized in type and of an aching character. He came to the hospital for relief of this pain. The general physical examination was unimportant except for enlarged glands in the groins, those on the right somewhat larger than on the left. The left heel on palpation appeared to be about one-third broader than normal, the resistance appearing to be quite superficial with a moderate degree of tenderness over the lateral aspects, with no discoloration of the skin, but perhaps a slight increase in surface heat. There was a scar 1 cm. in length underneath the heel. Blood Wassermann was negative. Roentgenograms of the chest were negative, and those of the heel showed what appeared to be destruction

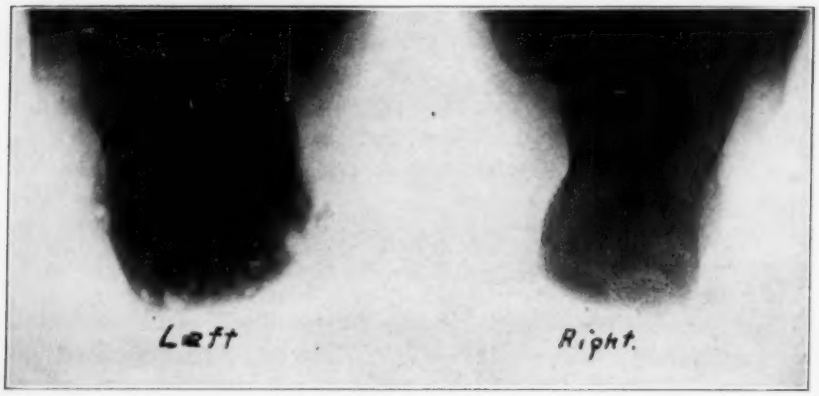


FIG. I

Shows the right and left os calcis in the anterior-posterior position. The left shows a marked increase in density with small irregularly circular areas of rarefaction particularly marked toward the periphery. There is no epiphyseal line perceptible in this view.

FIG. II

Shows the normal right os calcis in the lateral position. The epiphysis has not entirely fused.

throughout the epiphyseal portion. There was increased density of the entire body of the bone with proliferation of the periosteum of the lateral aspect. W.B.C.—11,000; von Pirquet negative; urine normal.

Operative Note. On May 22, 1925, an incision two and one-half inches in length was made over the lateral aspect of the os calcis. There was increased vascularity of the part with slight irregularity of the periosteum. A plug of bone consisting of the full thickness of the part was then removed with a trephine. The bone was much

FIG. III

Shows a marked eburnation of the entire posterior two-thirds of the left os calcis, with punched-out areas along the epiphysis and proliferation of the periosteum upon the inferior surface.

eburnated, and to a depth of one-half inch showed no evidence of cancellous bone. There was an apparent increase in vascularity of the periosteum. A small cuneiform piece of bone extending to the epiphysis was removed with an osteotome. Again the bone was eburnated to the same depth; there was no evidence of suppuration. All bleeding was stopped and the wound closed with interrupted sutures; interrupted silk to the skin. A plaster boot was applied with the foot in right angle position. The culture taken from the wound showed no growth.

Pathological Examination (Reported by Dr. H. T. Karsner). Soft Tissue: This consisted of fibrous tissue generally closely packed together. Cells of the lymphocyte series have infiltrated in a few small regions. One large region of infiltration is about an artery.

Bone: The bony structure is slightly thickened. The medullary spaces are composed of fibrous tissue. Considerable fibrous tissue is between the tissue.

Diagnosis: Fibrous and chronic inflammation.

A search through many of the sections failed to show the presence of any organisms.

The history of an infection is quite clear and the symptoms rather typical. One is impressed with the similarity of the roentgenographic findings to that of epiphysitis occurring in the long bones, tending to establish a rather strong case for infection as an etiologic factor in its production.

To return, however, to a discussion of the pathology, we find in this case, as in others reported, an increased vascularity with slight irregularity, an increase in the size of the bone (bone volume), thickening and eburnation of the cortex, and a decrease in the cancellous bone. Cancellous bone in some cases may be completely obliterated (as reported in Henderson's case), the lacunae appear to be over-active in production of bone, and the vascularity of the medullary portion is decreased as a result of encroachment upon all sides by the enlarged and thickened cortex. This case, although classified as one of non-suppurative sclerosing osteomyelitis, would seem to suggest the relationship to epiphysitis or osteochondritis.

CONGENITAL MALPOSITION OF THE LEFT FIBULA

BY GEORGE E. BENNETT, M.D., BALTIMORE, MD.

The patient, a woman, twenty-one years of age, was admitted to the Johns Hopkins Hospital on August 5, 1925, presenting a very unusual deformity of the left ankle. There was a marked valgus with a congenital

FIG. 1

Before operation. Note position of the lower end of the fibula-posterior and internal to the astragalus. Also marked malformation of the astragalus.

malposition of the lower third of the fibula. From above the fibula extended in its normal course to about the mid third. At this point it passed posterior and just to the inner side of the tibia and formed a huge internal malleolus. The X-ray examination (Figure 1) shows the lower end of the fibula to be posterior and internal to the ankle joint.

FIG. 2
Post operative.

FIG. 3
Post operative.

FIG. 5

FIG. 4

Photographs of patient after operation.

The patient was operated upon on August 6, 1925. Incision was made about the internal malleolus, and the fibula freed. A second incision was made over the outer side of the ankle joint, extending up to the middle third of the leg. The fibula was dissected free and a transverse osteotomy done. The lower end of the fibula was removed. The astragalus and the internal malleolus were remodeled to bring the astragalus into a better position, the fibula was then transplanted to its normal position and fixed in this position by means of living suture, made of a strip of fascia lata, passing directly through the tibia and looping around the fibula, holding it in a good position with a very satisfactory anchorage. The patient made an uneventful recovery, and at the date of writing is able to bear a moderate amount of weight on the foot. A very slight equinus deformity existed, but no attempt was made to correct this as there is a slight shortening of the left leg.

While one very frequently sees unusual deformities of the ankle joint, the above described deformity is the first of its kind that I have seen and the operation seems to meet the condition very satisfactorily.

ANTERIOR TARSECTOMY (OLLIER) IN TUBERCULOSIS OF THE ANTERIOR TARSUS

BY EMIL S. GEIST, M.D., MINNEAPOLIS, MINN.

Various text books on orthopaedic surgery (Lange, Bradford and Lovett, Jones and Lovett, Joachimsthal), as well as special articles (Sever,[1] Nutt,[2]) speak in practically one breath of tuberculosis of the ankle and of tuberculosis of the tarsus. The impression conveyed is that the treatment is practically alike in both cases.

It is, of course, a fact that the treatment of both conditions follows the general principles of treatment of all surgical tuberculosis, but here the similarity ends.

In tuberculosis of the ankle, it is difficult to obtain bony fixation; when it is attained, we are still in doubt whether, after all, amputation at the point of election might not be preferable to a stiff ankle in the best possible position. On the other hand, in tuberculosis of that portion of the tarsus near or between the Chopart and Lisfranc joints, the proposition is different; resection of the diseased area is simple, easy, and the entire operation is often done in normal tissue; as an end-result, we obtain a healthy, useful, and somewhat shortened foot.

I did this operation on two cases (and no doubt others have done it) when, on investigation, I found that Ollier described it in 1891 in the Revue d'Orthopédie. As far as I can ascertain, this was its last appearance in medical literature. This operation deserves to be rescued from oblivion, dusted off, and perhaps brushed up a bit.

Let Ollier speak: "The anterior tarsus is made up of five bones,—scaphoid, three cuneiforms, and the cuboid; it forms a distinct region from the point of view of operative surgery. Situated as it is between Chopart's and Lisfranc's joints, it represents a section of the foot almost regular in outline which one can eliminate without interfering materially with the form or the function of the foot. The foot becomes more short. The orthopaedic and functional results which are obtained by this resection have been so satisfactory that we recommend this typical resection, or resection of this entire region, even in those cases where one can conserve the greater portion of it. . . . The removal of the bones in question constitutes a typical and well-defined operation—anterior total

tarsectomy. It is under this name that we described this operation in our various communications since 1883."

Ollier and his pupils did this operation in ten cases. One patient died of meningitis two years following the operation. The nine others lived and did well; they walked without brace and all took up their previous mode of life. The youngest was twelve years old and the oldest forty-six.

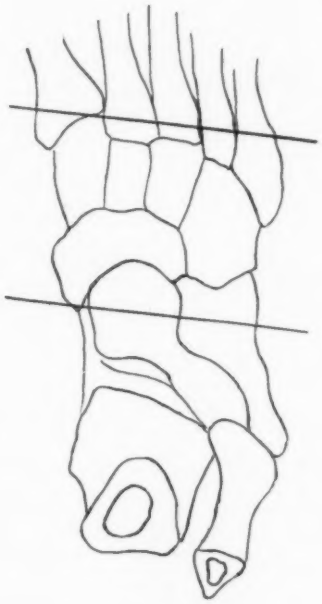


FIG. 1

Total Anterior Tarsectomy (Tracing from Fick).

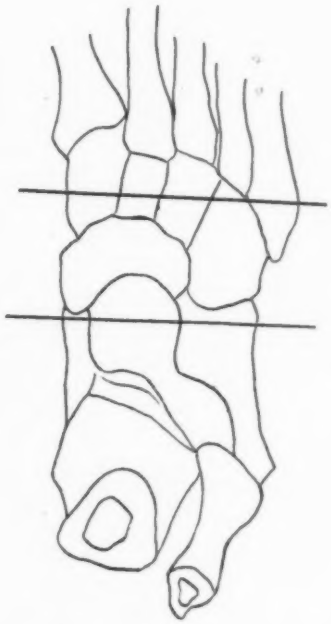


FIG. 2

Partial Anterior Tarsectomy (Chopart's Joint) (Tracing from Fick).

Apparently all of these operations were done for tuberculosis of the tarsus, although Ollier is not definite on this point.

Ollier did his operation through four incisions parallel to the long axis of the foot. To judge from the description and from the illustration, it probably constituted an exarticulation of all bony structures between Chopart's and Lisfranc's joints. It must have been a difficult and tedious job; also, it might easily have been an incomplete job in other than Ollier's hands. Nevertheless his results, above quoted, were excellent.

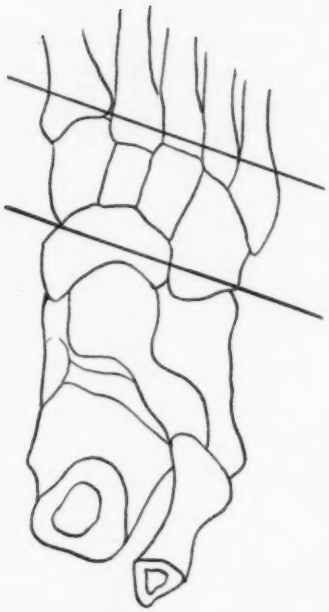


FIG. 3

Partial Anterior Tarsectomy (Lisfranc's Joint) (Tracing from Fick).

FIG. 4

End Result After Total Anterior Tarsectomy (From Ollier).

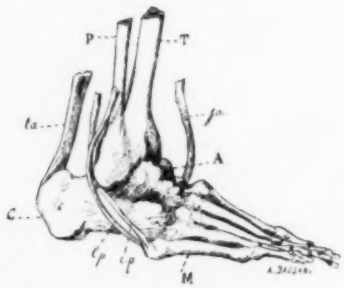


FIG. 5

Dissected Foot After Total Anterior Tarsectomy (From Ollier).

We make a transverse incision squarely across the dorsum of the foot, long enough so that we can easily bare both sides as well as the dorsum of the bones of the tarsal region. Blood vessels, nerves, tendons, and muscles on the dorsum are ruthlessly divided. This practically skeletizes the foot between Chopart's and Lisfranc's joints and beyond. We can then cut away any desired section of the tarsus extending from the neck of the astragalus up to and including the bases of the metatarsal bones, the block of bone being removed by means of the ordinary amputation saw. The saw cuts should be parallel. (Figures 1, 2, 3.) Following this, the cut bone surfaces are approximated. It is well to sew periosteum with a few chromic stay sutures. The divided tendons are reunited; the dorsalis pedis artery is tied off; this is followed by closure, dressings, and plaster cast.

We have observed no sloughing of the wound edge in any case. The skin over the dorsum of the foot and toes remains anesthetic for from six to twelve months, but in our operated cases it has regained sensibility.

We have operated only upon adults.

In the past six years, we have seen in private practice eight cases of tuberculosis of this region. Their treatment can be tabulated as follows:

Ollier operation	4 cases	
Amputation	2 "	(grave involvement)
Not treated	2 "	

One of our four "Ollier" cases had a recurrence and a later amputation was done. The other three are at this time well and working at their previous occupations. These three successful cases were operated upon in the following years respectively: 1920, 1921, and 1923. The shortest "cure" is therefore of nearly three years' duration.

The foot in the cured case is well depicted in Ollier's drawing (Fig. 4) and its roentgenographic appearance is in general that of Ollier's drawing of the skeletized foot after this operation (Fig 5).

REFERENCES

1. Sever, J. W.: Journal A. M. A., December 17, 1910.
2. Nutt, J. J.: Diseases and Deformities of the Foot, 1913.
3. Ollier: De la tarsectomie antérieure totale. Revue d'orthopédie, Vol. 11, p. 174, 1891.

A TRACTION LOOP FOR THE FOOT

BY JOHN L. PORTER, M.D., EVANSTON, ILLINOIS

There are many methods of applying traction to a foot and leg. The knot here described has been found very useful and simple. The material used is a filet about five feet long and one and one-half inches wide made of two or three layers of canvas. The middle point is placed over the dorsum of the leg just above the ankle joint. Then by making a series of angles and triangles as illustrated in Figures 1 to 4, the knot is completed. Considerable traction can be exerted without constriction or discomfort. A thin layer of felt or several layers of sheet wadding over stockinette may be used before the traction loop is applied. If a cast is applied over the knot the latter is removed through two lateral windows.

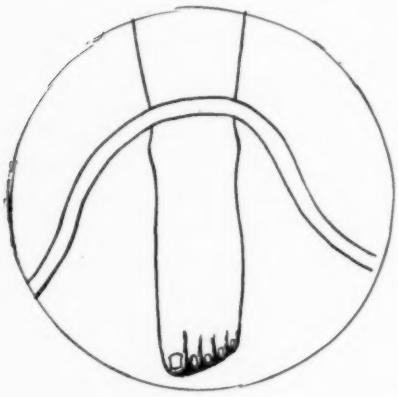


FIG. 1

The mid point of the filet is placed over the dorsum of the leg just above the ankle joint.

FIG. 2

The filet is reversed, forming a loop opposite the external malleolus.

FIG. 3

The other side is reversed, forming a loop opposite the internal malleolus.

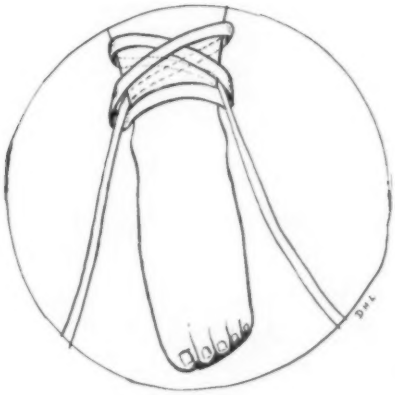


FIG. 4

The end which made first loop is carried behind and across the leg and passed through the outer malleolus loop. The second loop crosses behind the leg and its end is passed through the inner malleolus loop.

AN APPARATUS FOR THE CORRECTION OF FLEXION CONTRACTURE OF THE KNEE

BY WILLIS C. CAMPBELL, M.D., MEMPHIS, TENN., AND J. M. MITCHNER, M.D., HOUSTON, TEXAS

Flexion contractures of the knee vary in severity from the very mildest, occurring in connection with recent slight inflammatory conditions in and around the joint, to that associated with complete bony ankylosis. The former type can be easily straightened by simple extension, while in the latter an arthroplasty with the formation of a new joint is necessary.

Between these two extremes there are a large number of cases, usually of long duration, fixed in flexion by contracted tendons, dense bands of fibrous and scar tissue, both intra and extra articular, which it is impossible to straighten by the usual traction apparatus. When the flexion deformity is associated with genu valgum and external rotation the problem is very difficult.

In many of the chronic infectious arthritis cases with one or both knees fixed in from 45 to 60 degrees of flexion a fairly good functional result can be expected if the knees can be straightened. The articular surfaces of the joint are in too good a condition to warrant a resection or arthroplasty, and an osteotomy of the femur is inefficient and undesirable. It is in this type of joint that we have obtained the next gratifying results from gradual extension by the apparatus to be described. Again, in infantile paralysis cases of long standing with extreme flexion contractures of the knees 90 degrees and above, our only method of correction had been either a resection of the knee with a resulting stiff joint, particularly bad in bilateral cases, or a second stage operation, first on the soft parts and later an osteotomy. By gradual extension these knees can either be fully straightened or brought to a stage where an osteotomy will complete the correction.

Any appliance for the correction of this common deformity must not only extend the knee, but must prevent backward subluxation of the tibia and take into consideration valgum and rotary difficulties. For this purpose we have constructed an apparatus which has been found efficient in over thirty cases during the past year. In all cases in which the flexion did not exceed 90 degrees full correction has been attained. In those above 90 degrees, however severe, we have attained sufficient extension

of the knee to permit full correction by operation. In those with extensive deformity, correction by operation can only be accomplished by excising the joint. With the aid of the apparatus the articulation and knee motion are conserved. The after-treatment consists of a knee brace by which general motion can be instituted unless there is irreparable intra-articular damage. Muscle training and physiotherapy are employed when possible.

The apparatus consists of several additions to a Sinclair modification of the Thomas splint.

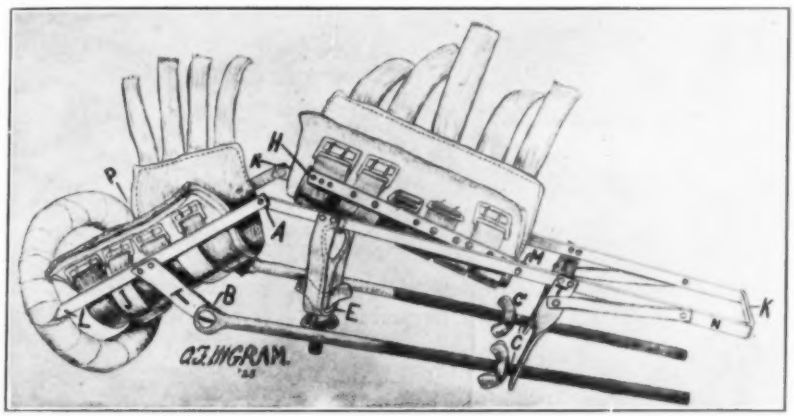


FIG. I

In the apparatus shown in Figure I the following measurements are taken:

1. Circumference of thigh at upper end L P.
2. Length of inner thigh from P to A (middle of knee joint).
3. Length of lower leg from A to sole of foot through malleoli plus 10 inches.
4. Length of lower leg one inch below tibial tubercle to two inches above malleoli, H M.
5. Circumference of thigh at middle, 3 inches above knee, greatest circumference of knee, lower leg 3 inches below knee, middle of lower leg, two inches above malleoli and at ankle joint.
6. Angle of contracture at the knee.

Application: The leg is first shaved from the knee down, sponged with ether, and two strips of adhesive plaster applied as in Buck's extension,

care being taken to place a small pad between the plaster and the malleoli and to have the straps sufficiently long to permit several wraps and a tie around the end of the splint K. We have tried the use of a leather anklet for traction, but it does not give a sufficient pulling surface, causes pain locally, and swelling of the foot.

There has been no difficulty in application of the splint even in distended limbs, but should this occur a hinge should be placed at P with

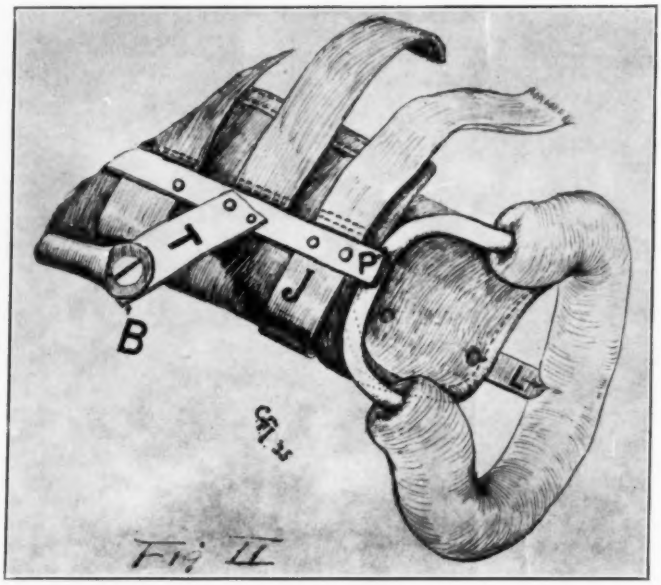


FIG. II

a catch at L. This addition should facilitate its use in the treatment of fractures. In cases where double apparatus is used, we find bulk in the perineal region causes discomfort to some patients; in these the inner bar is shortened and the ring is made (see Fig. 2).

The calf then lies in a similar trough, H M, which is inside the main splint A N. M is a movable joint. This trough extends along the back of the lower leg from a point opposite one inch below the tibial tubercle down to two inches above the malleoli.

Extension is then made on the leg, the straps being wrapped several times and tied at K. The thumb screws at E are adjusted so that the

pressure on the calf as it lies in H M is equal. The buckles of the canvas trough are fastened and the process of correcting the flexion contracture is ready to begin.

The action is simple. The extension through the pull at K separates the joint surfaces of the knee to some extent, assists in stretching the other tissues, and helps to correct any outward rotation in much the same manner as pulling the coil from a spiral spring.

Extension may be facilitated by suspending the end of splint K on a

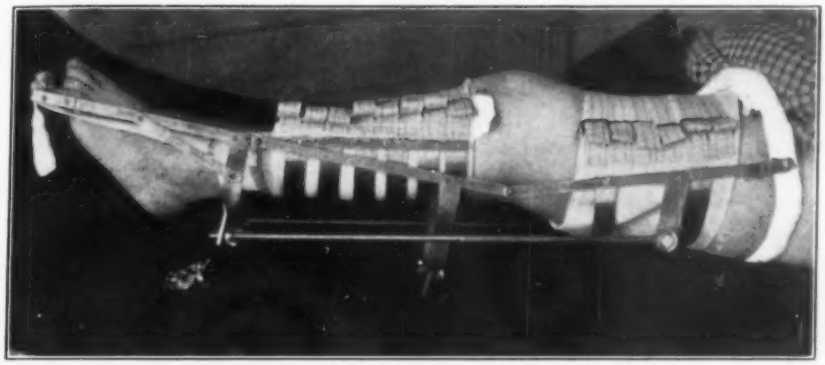


FIG. III

CASE NO. 14569: The right knee is now at the last few degrees of flexion, the hardest to correct. It will be noticed that the apparatus is partially hyperextended; this will be gradually increased to overcome these last degrees. From this stage on the force is reversed on the leg. At first applied through the bows and canvas trough posteriorly; now through the buckler on top. Although the straps of the buckler are placed close together to prevent pinching, it may be necessary to place a pad between them and the leg. The hyperextension is produced by the angle at which the short bars T T are attached to the long bars L A and A N.

support, allowing the leg in the apparatus to hang clear. The upward force through E, by pushing the upper end of the tibia forward on the femur, corrects subluxation of the tibia if present or prevents its occurrence during the correction. The thigh and lower leg are held securely in the splint by the canvas cuffs; upward displacement of the brace is prevented by the Thomas ring pressing against the ischium, and downward displacement by the pull on the leg attached to the lower end of the splint. The knee joint being the only movable point in the system, extension must take place at this point when the screw bar B C is extended. Both thumb screws C C and at F are kept as tight as the patient can bear

COMPLETED CASES IN WHICH FULL CORRECTION WAS OBTAINED

Case No.	Age	Diagnosis	Side	Duration	Deg. of Contr.	Sublux.	Rotation	Time Worn	After Treatment
14534	6	T. B.	Rt.	1 year	40	Slight	Slight	16 days	Cast
14324	16	T. B.	Rt.	5 years	45	Moderate	Moderate	3 weeks	Cast
13844	3	T. B.	Rt.	1 year	90	Moderate	Slight	Not stated	Cast
13526	9	T. B.	Rt.	6½ years	80	Moderate	Slight	2 mos. 9 dys.	Brace
14330	24	Inf. Arth.	Both knees	1 year	30 30	None	None	2 weeks	Brace
13872	7	Inf. Arth.	Both knees	4 years	90 90	Marked	Marked	1 mo. 25 days	Brace
12256	20	Inf. Arth.	Both knees	1 year	80 90	None	None	1 mo. 3 days.	Brace
13516	42	Inf. Arth.	Both knees	1 year	45 45	None	None	11 days	Brace
13551	68	Inf. Arth.	Lft. knee	2 weeks	40	None	None	4 days	Brace
13232	17	Inf. Arth.	Lft. knee	1 year	10	None	None	12 days	Brace
13221	13	Inf. Arth.	Lft. knee	5 months	90	None	None	2 mos. 9 dys.	Brace
13033	11	Inf. Arth.	Lft. knee	8 months	45	None	None	20 days	Brace
05200	3	Following osteomyelitis of femur	Rt. knee	6 months	90	None	None	Not stated	Night splint

COMPLETED CASES:

T. B.	right knee	4
Following osteomyelitis	right knee	1
Infectious arthritis	left knee	4
Infectious arthritis	both knees	4
	Total Cases	13
	TOTAL KNEES	17

CASES UNDER TREATMENT

Case No.	Age	Diagnosis	Side	Duration	Deg. of Contr.	Sublux.	Rotation	Time Worn	After Treatment
14569	48	Inf. Arth.	Lft. knee	9 years	35	None	None	Not stated, now 10 deg.	
13300	31	Inf. Arth.	Both knees	5 years	90 90	Moderate	Slight	Casts to 60 degs.	
12522	11	T. B.	Lft. knee	10½ years	35	Not stated	Not stated	2 mos., 20 degrees, not stated	

CASES PARTIALLY STRAIGHTENED, THEN CORRECTED BY OSTEOTOMY

05189	8	Inf. Arth.	Rt. knee	5 years	45	Not stated	Not stated	Not stated to 20 deg. before operation	
6981	13	Polio-myelitis	Lft. knee	10½ years	120	Marked	Marked	Eight weeks	Brought down to 30 deg. and completed by osteotomy of femur

The duration given is from the patients' statements as to the length of time the knee was in this position.

comfortably, yet not causing enough trauma to produce a flareup in the affected joint. The screw at F is permitted to force the tibia forward only enough to correct the subluxation or prevent it, and is then kept at this point. If stationary position is desired, double thumb screws may be placed at C C and E, acting opposite to each other.

The apparatus may be taken off from time to time in cases other than tuberculosis and the entire leg baked, massaged, etc. We find that this greatly shortens the time of treatment. In tubercular cases the canvas trough may be opened and the limb given heliotherapy or Alpine lamp treatments.

Each patient is carefully instructed as to the purpose of the apparatus and how to keep all adjustments in order. This has proved a great help in its use, especially when it was impossible to see the patient every day.

We are also using the apparatus in the treatment of fractures of the lower third of the femur, but have not as yet determined the relative value.

We have made no attempt to "refine" or "finish" the apparatus as it is used for only a short time and is made to measure for each patient. For general use this could be done, together with adjustable parts, so as to be suitable for different patients.

The mechanical principles in the apparatus are, of course, not original. There are several other types of apparatus in use based on the same principles, but after considerable experience with all of them we believe that the above apparatus is the most satisfactory for the following reasons:

1. It is simple and inexpensive to make, not requiring any equipment that is not present in the ordinary brace or machine shop.
2. It is durable, does not break or get out of order during the process of correction.
3. It can be removed and re-applied by nurses and physiotherapists, permitting care of the skin and treatments to the joint.
4. It is available whenever desired, as it can be made up from measurements in one day.

The appended tables will show the type of cases on which the apparatus has been used. The average time for correction is from three to six weeks.

A SIMPLE REMOVABLE HEAD SUSPENSION SLING

BY PHILIP LEWIN, M.D., CHICAGO

In the application of a plaster-of-Paris head, neck, or head and neck cast it is impractical to use the ordinary leather sling of Sayre because it is too bulky and cannot be removed. As a substitute, therefore, there is here offered a simple head suspension sling.*

FIG. 1

Strip of heavy bandage material or Canton flannel with linear slit.

This sling is made of a strip of heavy roller bandage or Canton flannel about forty-eight inches long and six inches wide. A linear slit about ten inches long is made through the middle. The head passes through the slit, and the front half is placed under the chin and the back half under the occiput. Loops are tied at each end for the hooks of the metal Sayre suspension apparatus.

When the cast is complete two cuts are made on one side and the bandage is pulled through on the other.

*The same method has been used by Dr. Rudolph Reich in making foot traction.

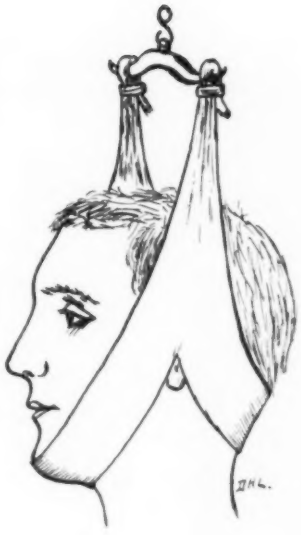


FIG. 2

Patient suspended preparatory to application of plaster-of-Paris cast.

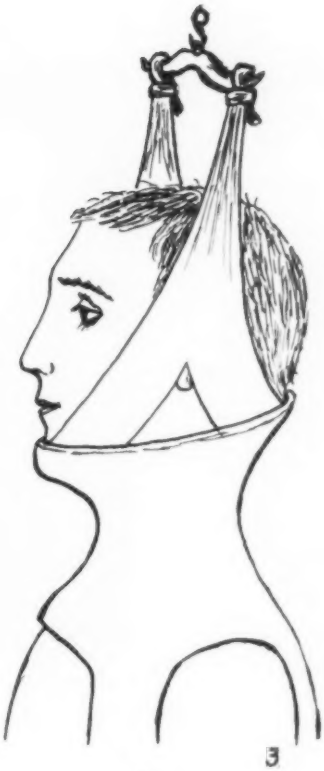


FIG. 3

Cast complete; sling still in place.

FIG. 4

The type of cast in the application of which the sling is especially useful.

A CLUBFOOT WRENCH

BY DAVID R. TELSON, M.D., BROOKLYN, N. Y.

In devising an instrument to give a more thorough correction of rigid clubfeet or flat feet, I attempted to modify the Thomas wrench. I had found that many deformed feet could be reduced by the closed method if sufficient leverage were obtained by mechanical means. Even in cases where it was impossible to obtain a reduction without the aid of an open operation, I was able to convert the type of this operation to a much less mutilating one. For instance, I believe that a mid-tarsal wedge removal in a child, although it may reduce the varus which is present, always prepares for later life an ugly pod instead of a well-shaped foot. If, however, the metatarsus varus can be reduced by the closed method, the removal of the sub-astragular wedge allows correction of the inversion of the os calcis. This operation I consider to be much less mutilating.

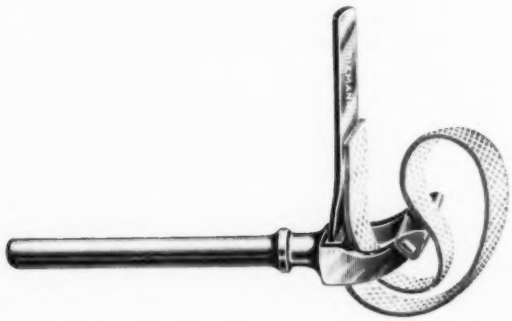
According to Dr. Royal Whitman, the great advantage of a closed reduction over an open is the fact that in wrenching, no structure is ever torn which is not an impediment to the correction. The structures are torn in the order in which they block manipulation. In the open operation, structures are cut in the order in which they lie in relation to the skin. That is, tissues are severed which are not hindering reduction, but must be incised simply because of the fact that they lie between the skin and the offending ligament.

I have adapted a tool used by mechanics which I believe is so powerful that any desired correction can be obtained, including fracture of the bones if necessary. At the same time the site of application of the instrument is not at all injured. I have torn a foot from the leg on the cadaver without being able to demonstrate any appreciable injury to the tissues at the site of application of the wrench.

The foot is first covered with a single layer of a three-inch rubber Esmarch bandage. The wrench is then applied as shown in Figure 2, with the concavity of the face of the wrench applied to conform with the inner border of the forefoot in the case of a clubfoot, and to the outer border of the forefoot in the case of flat feet.

The flat bar is particularly useful in the correction of cases where equinus is present in conjunction with varus or valgus. A slight two-

finger pull on the end of the handle gives all the correction that is desirable. I have used this wrench on the service of Dr. Jacques Rushmore at the Long Island College Hospital and on the service of Dr. F. H. Albee at the Post Graduate Hospital, with very gratifying results and no untoward evidences of trauma. It has saved us many open operations and converted several more formidable procedures into sub-astragular removals of wedges.



ST. LUKE'S FRACTURE BED

BY R. L. DRESEL, M.D., SAN FRANCISCO, CALIFORNIA

From the Orthopaedic Service of St. Luke's Hospital, San Francisco, Calif.

About the beginning of 1925 I started work on a fracture bed which should fill the following requirements:

1. Completeness.
2. Durability (strong and of light weight).
3. Stability. Impossible to tear asunder, without the aid of a crowbar.
4. Ease of operation.

The St. Luke's fracture bed, with a complete line of standard splints made to fit the bed, enables us to care for our difficult fracture cases permanently in a fraction of the time usually required, as the bed is complete and cannot be "robbed" of any of its parts. There are no delays awaiting the fabrication of splints, pulleys, traction, etc., with subsequent reapplication and inconvenience to doctor and patient.

The basis of the bed is an ordinary fracture bed plus a non-removable Balkan frame with certain modifications. There is a ratchet for raising and lowering the mattress instead of a cable, which often becomes twisted and broken. Other points to observe about the bed are that there is a mechanism to lock wheels; a mechanism to raise and lower the foot of bed without having to resort to blocks; good castors instead of poor ones; an overhead structure (made of ¾" piping) permanently attached to the bed. There is no chance of losing parts nor any labor in erecting the bed.

The overhead structure consists of a continuation of the four uprights at each corner of the bed connected above.

At the head of the bed there is a crossbar between uprights arranged so that it can be lowered and raised at will, held by pins spaced every four inches. There are two pulleys so arranged (held also with pins) as to slide from side to side on the crossbar, and so that a rope bearing weights falls free of bed without friction.

At the foot of the bed there are two crossbars like those at head, because it may be desirable to attach both a Thomas splint and a knee flexion bar.

On top there is a crosspiece (A) so arranged that it can slide toward either the foot or the head of the bed alongside pipes. The pulleys are held with clamps, which can be moved along the crosspiece from side to side, but not removed from bed.

In the illustration may be seen another crosspiece (B) with a perpendicular bar (C) attached with a hinge at (a), which perpendicular bar (C)

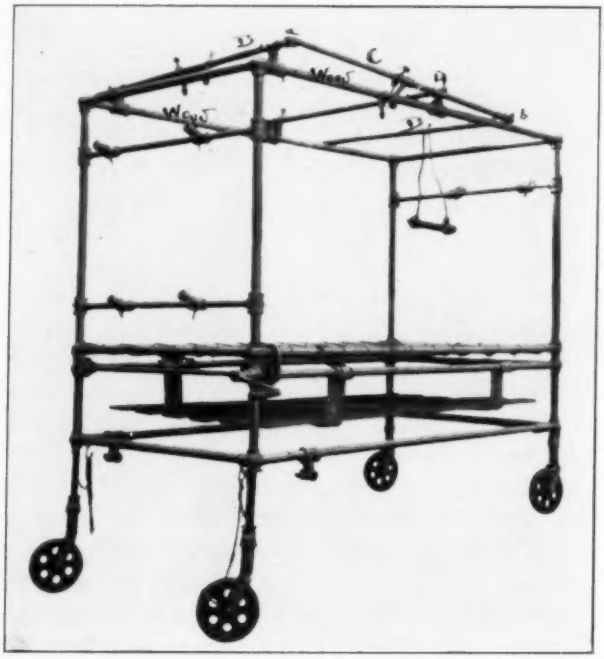


FIG. 1

attaches to a horizontal piece (D) by means of a hinge (b). This bar (C) has a pulley and a rest (d and e) attached for securing either an arm splint or a leg splint in abduction. (Note that the crosspiece (B) is between the head of the bed and the crosspiece (A), a position which can be reversed at will, depending upon the use of the bar (C), whether for an abducted arm or an abducted leg.)

This upper part of the appliance (B. C. D.) can be swung up to rest above the bed and out of the way without taking any part of bed apart. When resting on top of the bed it can be so placed as to serve to support

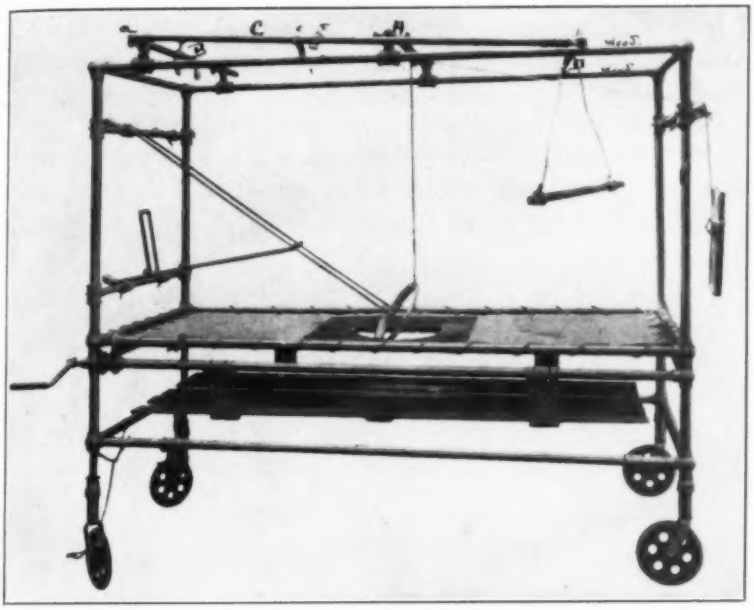


FIG. 2

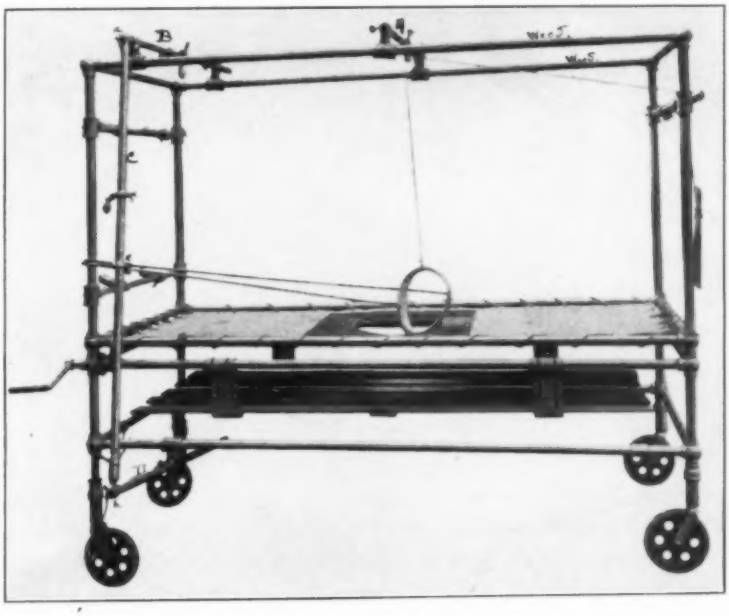


FIG. 3

slings (for pelvis) or a trapeze so that the patient can lift himself. All crosspieces have freely movable pulleys attached which cannot be removed from the bed.

The appliance (B. C. D.) can be interchanged so as to be used for a right or a left extremity. The crosspieces (A. and B.) can also be exchanged so that either one may be nearer the foot or the head of the bed as desired.

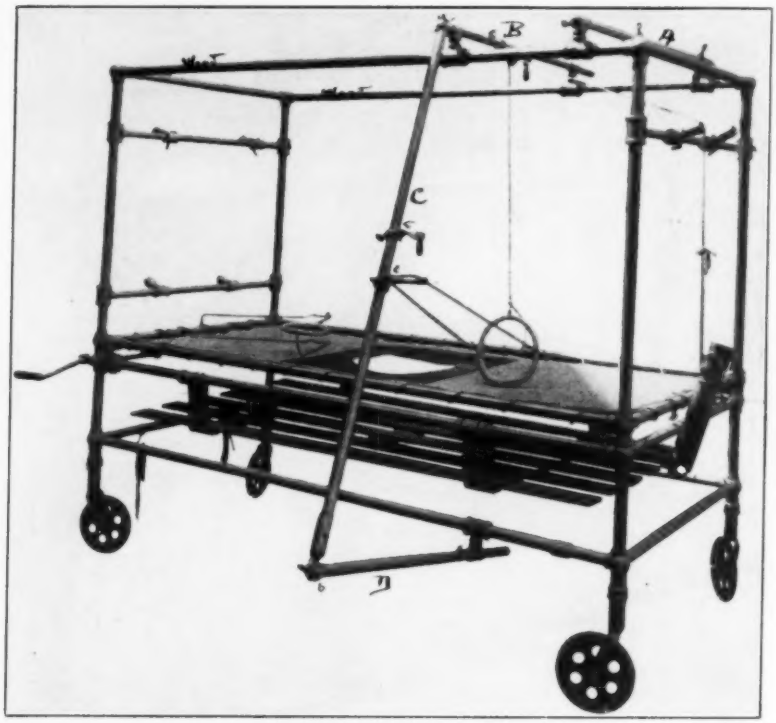


FIG. 4

Because of the use of high tension wires on a portable X-ray machine the two upper longitudinal rods marked "wood" in the illustration were made of wood, it being found dangerous to use iron throughout. It was found that with these rods made of wood, all positions needed could be obtained with the X-ray tube and still have all other parts composed of iron, thus strengthening the entire structure.

Needless to say, all Thomas splints are the same length (from middle to foot of bed) notwithstanding the circumference of the ring.

The entire bed can be put into an elevator, sent to the X-ray or the operating room, wheeled outdoors (even if the foot of bed is raised for countertraction) without any trouble whatever. Further, all arm splints which hang out from the side of bed are "firmly" attached to bed and not hung by a string from some overhead crane. Everything is tight and secure.

CLINICAL CONFERENCE AT THE HOSPITAL FOR THE RUPTURED AND CRIPPLED, NEW YORK, OCTOBER, 1925

DR. BUCHMAN—Result of Reconstruction Operation for Osteoarthritis.

Dr. Buchman presented a woman, 60 years of age, who was admitted to the hospital in August, 1925. The examination disclosed a typical, rather marked arthritis deformans of the right hip joint of five years' duration. This had become progressively more painful and disabling in spite of much conservative treatment. There was also some painless disability of the right knee joint due to arthritis deformans.

A typical reconstruction operation was performed. The upper part of the capsule of the joint was found to be replaced by a bony arch, concavity downward. This was removed. The femoral head and the acetabular cavity were irregular and the cartilage was eroded. The diseased bone was very hard. The femoral head was removed and the newly formed head was inserted into the acetabulum. The greater trochanter was displaced downward on the femoral shaft and the wound was closed.

The convalescence was uneventful. All the pain ceased within a few days after the operation. The patient was kept in a long plaster-of-Paris spica for four weeks. Following that, a suspension apparatus allowing all motions about the hip and knee joints was applied. Seven weeks after the operation, the patient was allowed up and out of bed on crutches.

The post-operative roentgenogram showed the reconstructed head in the acetabulum, the greater trochanter displaced downward, absence of the bony capsule, and a few remaining osteophytes.

On discharge, the patient was able to walk without pain, with the aid of crutches. There was very little motion in the hip joint. The limb, however, was in 20 degrees abduction and in complete extension. Nine weeks after operation there was about 10 degrees of motion in all directions. The joint was painless. The only discomfort was in the right knee joint and in the small of the back.

This patient was presented to show the extensive pathology in the hip joint, the rapid relief of symptoms, and the rapid convalescence.

DR. L. C. WAGNER—Fracture of External Condyle of the Femur; Union; Fragment Blocking Extension of the Knee. Removal of Fragment.

Dr. Wagner presented the patient, 19 years old, who, while dancing in April, 1922, slipped and fell, injuring her left knee. She had been treated conservatively with the hope that the fragment might absorb or unite in its normal position. But instead the fragment had pushed forward, uniting and limiting extension by impinging upon the tibia.

Roentgenogram showed firm union between the fragment and femur and that they are united anteriorly.

On examination before operation in September, 1925, patient walked without a limp. She could extend the leg to 165 degrees and flex beyond a right angle. There

was no pain. There was a slight compensatory knock-knee and subluxation posterior of the tibia. Patient was very athletic and suffered no inconvenience from the knee.

On October 10, under ethylene, the left knee was exposed through medial incision and the fragment removed with a chisel. The joint was otherwise normal and the area from which the fragment first belonged was now covered with cartilage. The knee was stretched to complete extension very easily and the broken fragment was removed.

DR. B. WHITBECK—Bilateral Congenital Dislocation of Patellae; Two Cases in Family.

Dr. Whitbeck presented two cases of bilateral congenital dislocation of the patellae, of special interest because the patients were brothers.

The father brought the older boy with a history that since the boy had learned to walk, he had, even when walking about the house, frequently fallen without any apparent reason. There never had been any history of an injury. On examination it was found that both patellae were decidedly undeveloped, especially the left. The patella on the right was about the size or a little larger than a twenty-five cent piece, the left one even smaller. Both patellae were displaced outward, lying on the outer side of the external condyles of the femora, and could be partially displaced inward but not entirely reduced to their normal positions. When the boy stood up and walked, there was evidence of marked weakness in the knees and a tendency toward sudden flexion. Operation was advised and accepted.

Two incisions were made on either side of the patella through the skin and subcutaneous tissues. The borders of the patella were exposed and the outer border of the patella freed from the surrounding tissues to permit a free displacement inward. Two holes were then drilled in the patella about three-quarters of an inch apart and also two holes in the internal condyle the same distance apart. Then a strip of fascia was removed from the external surface of the thigh and by means of a probe attached to a catgut suture the fascia in the form of a ligature was drawn through one hole in the patella and through a hole in the condyle, back to the second hole in the condyle, and through the second hole in the patella. With the patella held in its normal position, the ligature was drawn tight and sutured firmly with chromic gut. The tissues on either side of the patella were then sutured with chromic gut, and skin sutures closed with No. 1 catgut.

The operation on the right side was successful; that on the left not entirely so, permitting some lateral displacement of the patella. The second operation was performed, drawing the patella over more firmly with No. 2 chromic gut. The tissues were again sutured with a satisfactory result. The boy now walks in a normal manner without any sense of weakness. The patellae are in normal position and function normally.

Following the success of this operation, the father brought the second child, with practically the same history of falling without apparent reason. Examination of this child revealed the same condition which previously existed in the older brother, except that the patellae were not displaced quite so far externally and were found to lie just over the external border of the condyle. The patellae were undersized and could be displaced inward but did not hold their position. Operation has been advised in this case but the parents have not yet consented.

The father says that there is a third child with the same condition.

DR. R. WHITMAN—Bilateral Bifurcation Operation for Congenital Dislocation of Hips.

Dr. Whitman presented a boy 9 years of age, illustrating the effect of a Lorenz bifurcation operation for bilateral congenital dislocation of the hips.

In this operation the femora had been divided in an oblique direction from a point opposite the acetabula and the sharp fragments had been thrust inward to form a new support at the normal position. Before this operation the patient had been practically disabled from pain and weakness. Now he walks about without discomfort, and the range of motion in all directions is but slightly restricted. This operation was considered to be particularly indicated in irreducible bilateral dislocations, accompanied as in this instance by pain.

Dr. Whitman presented also two other cases illustrating a further application of the bifurcation operation.

The first of these was for hip disease of long standing, accompanied by deformity and by distinctive changes in the joint. The patient, a man 25 years of age, had been free from disability other than that caused by the deformity of the limb for many years, but recently had suffered almost constant pain in the joint. This was apparently explained by a secondary arthritis of mechanical origin at the defective articulation. The operation had the advantage of correcting the deformity, and by providing a new bearing surface would relieve the friction which had been the cause of discomfort.

The second case was so similar that no separate description seemed necessary, since both patients were still under treatment.

DR. S. KLEINBERG—A Case of Traumatic Spondylolisthesis.

J. P., 50 years old, was presented on account of a probable traumatic subluxation of the fourth lumbar vertebra due to muscular violence. Two years ago while prying a rock loose he felt a sharp pain in the lower part of the back and was obliged to stop work. The backache and disability have continued up to the present time.

Examination shows a characteristic groove just above the middle of the sacrum. There is localized pain and tenderness in this area. Motions of the spine are restricted and painful. A lateral roentgenogram shows a forward displacement of the fourth lumbar vertebra for a distance of about one quarter of an inch. Neurological examination is negative.

Prior to the alleged accident this man was perfectly well and was able to move his back freely and work without any discomfort. Since his injury he has not been able to work at all and has had continuous pain. It cannot be denied that this man may have had a congenital lesion of the lumbar area which predisposed him to a dislocation, but it appears logical and reasonable to assume, that, inasmuch as the man was well before the injury and has been incapacitated continuously since then, the present lesion of forward subluxation of the fourth lumbar vertebra, or spondylolisthesis, is due to this injury: that is, it is traumatic in origin.

DR. I. BALENSWEIG—Congenital Dislocation of Hip. Open Reduction.

Dr. Balensweig presented the case of E. L., female, age 13 years, who was first observed in November, 1924, complaining of pain across the lower part of the back and a marked left hip limp. The history was typical of a congenital malformation. No treatment had been received prior to the time of observation. Examination revealed the patient to be in good general condition, walking about awkwardly with a left hip limp. She also presented a moderate lordosis. Movements of the left hip were free

except abduction and flexion which were partially restricted. Motions were painless and not accompanied by muscle spasm. The head of the femur was palpable posteriorly and could be moved in a vertical direction, indicating what is described as telescoping. The greater trochanter was found to be well above Nélaton's line. Mensuration disclosed two and one-half inches of shortening, one inch atrophy of the thigh, and one and one-half inches atrophy of the calf when compared with the opposite limb.

The roentgenogram (November, 1924) showed a lack of development of the left half of the pelvis, a very shallow acetabulum, and a displacement of the head of the femur upward and backward on the ilium. No secondary acetabulum was to be observed.

The patient was admitted to the Hospital for the Ruptured and Crippled on December 12, 1924, and fifteen pounds traction applied to the left lower extremity. Roentgenogram on December 23, 1924, showed the head of the femur to be at the level of the upper rim of the acetabulum. The traction was increased to twenty pounds and the hip operated upon on January 2, 1925. The hip joint was exposed through an antero-lateral incision extending downward from the anterior superior spine to below the greater trochanter. The thickened capsule was sectioned and the head of the femur brought into view. The latter was conical in shape and required the removal of several segments to give it a rounded appearance. With the aid of the Doyen reamers a new acetabulum was formed in the upper half of the old acetabulum and the head placed within. The wound was sutured in layers, using chromic catgut for the deeper structures and plain catgut for the subcutaneous tissues and the skin. No drains were used. Long plaster spica bandage applied and the patient returned to the ward in good condition.

The plaster was bivalved on the thirty-third post-operative day and the hip and extremity massaged daily. The patient was allowed home on the fifty-ninth post-operative day, able to walk about without assistance for short distances. Has since that time received physical therapy with noticeable improvement. Examination in October, 1925, showed that the patient walked with a more stable gait, without the presence of a lordosis, and with a fair range of motion of the operated hip. The range of flexion was 65 degrees, abduction 15 degrees, and internal rotation 15 degrees. Mensuration disclosed a shortening of one and one-quarter inches.

The roentgenogram in October, 1925, showed a well-formed acetabulum that is much deeper and larger than that made at the time of operation and a well-formed femoral head that has remained within the newly formed acetabulum.

The result is to be considered satisfactory.

Dr. L. C. Wagner—Dislocation of Scaphoid of Wrist. Marked Ulnar Deviation of Hand. Removal of Fragment.

Dr. Wagner presented this patient, 34 years old, who has been in perfect health. On April 30, 1925, while in a quarrel, he hit his opponent with a sweeping blow, and was unable afterwards to straighten his wrist. An attempt to reduce it under anesthetic was made twice by his family physician, only with increase of the swelling and no decrease of the deformity. Ten days later examination showed marked swelling of the right wrist. Practically no movement. It was fixed in the attitude of the ulnar deflection at an angle of about forty-five degrees. There was marked tenderness and discomfort about the wrist. There was a marked prominence in the region of the scaphoid. Roentgenogram showed dislocation of the scaphoid with its inner edge

fixed under the styloid process of the radius, which accounted for the fixed deformity. On May 12, two weeks after the accident, under ethylene, the right scaphoid was excised through the medial incision. The wound was closed and the arm placed in plaster for two weeks, and afterward physiotherapy was instituted but was discontinued after three weeks because the patient went away.

Examination on November 21 showed very little deformity of the right wrist. He returned to his old occupation and has had no pain. There is no swelling and he has complete extension, flexion, and lateral motion. He is able to use a screw driver, hammer, or pick up small objects.

DR. KRIDA—Traumatic Arthritis of the Knee Joint—Operative Findings.

Dr. Krida presented a man 50 years of age, a Scandinavian sailor, who was held up late one night ten months ago. He was hit on the head, dragged across the road, and when he woke up three-quarters of an hour later, he could not move his right knee. At first the knee was discolored and swollen. He was in bed ten days.

Three weeks after his injury the knee presented symptoms of internal derangement referred to the inner side of the joint, together with pain about the upper border of the patella. The joint was still somewhat enlarged, very tender about the head of the tibia on the inner border, and on the anterior articular surface of the internal condyle. A plaster-of-Paris bandage was applied and left on for one month.

Two months after his injury he was operated upon because of the persistence of symptoms. Because of the marked tenderness about the patella, it was suspected that there was more extensive pathology than simple injury to the internal semilunar cartilage. The joint was accordingly widely opened by the typical antero-internal incision. The following pathologic condition presented:

(a) A synovial fringe one-quarter inch in thickness by three-quarters inch in length projecting into the joint from just above and to the outer side of the patella.

(b) Rather marked fibro-fatty enlargement of the fat pad tissues.

(c) The internal semilunar cartilage was quite free of attachment in its anterior fourth.

The synovial fringe, enlarged fat pad, and internal semilunar cartilage were excised.

There was perfect restoration of function. The case was shown primarily to emphasize the value of a thorough exploration, such as the larger incision allowed, in certain cases where other than sharply localized and differentiated pathology is suspected.

News Notes

Dr. Roland Hammond of Providence has been elected President of the Boston Orthopaedic Club. Dr. Hammond is also President of the Providence Medical Association.

Dr. E. J. Berkheiser has been appointed Attending Orthopaedic Surgeon to the Children's Memorial Hospital, Chicago.

The publishers of the American Journal of Electrotherapeutics and Radiology announce that the name of that periodical has been changed to Physical Therapeutics.

The State Department of Vocational Rehabilitation, Raleigh, N. C., has organized orthopaedic clinics over the State for the purpose of caring for the indigent cripples. Dr. Alonzo Myers, of Charlotte, N. C., is in charge. Clinics have already been established at Fayetteville and Charlotte, and one hundred and fifty-one cases examined.

The British Orthopaedic Association will hold a summer meeting in Paris, on May 21 and 22, 1926, visiting the surgical clinics of that city.

The Annual general meeting for 1926 will be held in London on October 29 and 30. At that meeting a discussion on "Injuries of the Carpus" will be opened by Mr. C. Max Page.

The Section in Orthopaedic Surgery of the New York Academy of Medicine met on Friday evening, January 15, 1926.

The programme was as follows:

PRESENTATION OF CASES, CASE REPORTS, AND NEW INSTRUMENTS.

(From the Staff of the Hospital for Ruptured and Crippled.)

(*a*) 1. Case of Sacro-iliac Arthritis.
2. Late Results in an Operation for Paralytic Valgus.
Percy W. Roberts.

(*b*) Bilateral Congenital Dislocation of Patellae—2 cases in one Family.
Brainerd H. Whitbeck.

(*c*) 1. Osteochondritis of Elbow.
2. Subluxation of 4th Lumbar Vertebra.
Samuel Kleinberg.

(*d*) Loose Bodies in Knee, with involvement of Patella—2 cases.
William L. Sneed.

(*e*) Reinforcement of Acetabulum for Paralytic and Congenital Dislocations of the Hip—3 cases.

Armitage Whitman.

(*f*) Cases Demonstrating Unusual Vertebral Injuries.

Irvin S. Balensweig (*by invitation*).

(*g*) Adolescent Kyphosis due to Vertebral Epiphysitis.

Joseph Buchman (*by invitation*).

(*h*) Dislocation of Scaphoid of Wrist. Marked Ulnar Deviation of Hand. Excision of Scaphoid.

Lewis Clark Wagner (*by invitation*).

(i) 1. Extensive Haemangioma of Knee Joint—Operation.
2. Reconstruction Anterior Crucial Ligament of Knee Joint—3 cases. (Lantern Slides.)

Arthur Krida.

PAPERS OF THE EVENING.

The Non-operative Treatment of Bursitis.

Charlton Wallace.

Significance of the Accessory Tarsal Scaphoid. (Lantern Slides.)

Isadore Zadek.

At a meeting on Friday evening, February 19, 1926, the following programme was presented:

PRESENTATION OF CASES, CASE REPORTS, AND NEW INSTRUMENTS.

(*From the Staff of Mt. Sinai Hospital.*)

(a) 1. Subluxation of the Patella as a Late Result of a Biceps Transplantion.
2. Transposition of the Insertion of the Achilles Tendon and Plantar Fascia (Lorenz Operation) to improve Lateral Balance of Foot,—in Paralytic Deformities. Three Cases.

Seth Selig (*by invitation*).

(*b*) 1. Demonstration of a Practical Plaster-of-Paris Bandage Roller.
2. Cases: Showing the Results of Implantation of Extensor Tendons for Claw Foot.

Edgar Oppenheimer.

(*c*) Popliteal (Brackett) Operation for Loose Body in Knee.

Sigmund Epstein.

PAPER OF THE EVENING.

The Place of the Orthopaedic Surgeon in the Treatment of the Chronic Patient.

Joel E. Goldthwait, Boston, Mass. (*by invitation*).

The Children's Bureau of the United States Department of Labor has issued a set of six charts on posture standards for boys and girls, intended for the use of physicians, nurses, physical education teachers, and clinics.

The charts were planned on the basis of extensive observation and measurement of school children by Dr. Armin Klein of Boston, who is in charge of posture clinics for the Massachusetts General Hospital and the Department of Health of the City of Boston. They will be useful, it is believed, in affording visual illustrations of posture types and groups for purposes of classification and comparison. In devising the charts it has been recognized that there are certain distinct types of physique and that the

standards of good and bad posture must be considered in relation to the physical type. Three types of figures are shown for both boys and girls—the thin, the intermediate, and the stocky. Each chart shows four silhouette figures illustrating excellent, good, poor, and bad posture for one type of girl or boy.

Descriptions of the distinguishing characteristics of excellent, good, poor, and bad posture are printed on each chart. In excellent posture, the charts point out, the head is up and the chin in; in good posture the head is slightly forward; in poor posture it is forward; in bad posture it is markedly forward. In excellent posture the chest is up and the breast bone is the part of the body farthest forward; in good posture the chest is slightly lowered; in poor posture it is flat; in bad posture it is depressed or sunken. In excellent posture the lower abdomen remains in and flat; in good posture it is in but not flat; in poor posture it is relaxed and is the part of the body farthest forward; in bad posture it is completely relaxed and protuberant. In excellent posture the curves of the back are within normal limits; in good posture they are slightly increased; in poor posture they are exaggerated; in bad posture they are extremely exaggerated.

Each chart is approximately 24 x 34 inches. A limited number of the charts are available for free distribution; others may be secured from the Government Printing Office for fifty cents a set.

The annual meeting of the American Orthopaedic Association will be held in Atlanta, Georgia, on Monday, Tuesday, and Wednesday, April 26, 27, and 28, 1926. The headquarters of the Association will be in the Hotel Biltmore. Members and guests desiring accommodations should write in advance to make their reservations. The first day will be devoted to demonstrations of treatment and results by Doctor Hoke and his staff. A banquet will be held at the Hotel Biltmore on Tuesday evening at seven o'clock. The programme committee has prepared a preliminary programme, as follows:

PRELIMINARY PROGRAM

Tuesday

9 A.M. Dr. Baer. End Results of Arthroplasties of the Hip.
Dr. Campbell. End Results of Arthroplasties of the Hip.
Dr. Armitage Whitman. End Results of the Whitman Reconstruction Operation on the Hip.
Asked to Discuss: Dr. Charles F. Painter
Dr. Albert H. Freiberg
Dr. Russell A. Hibbs.

12 M. First Executive Session.

2 P.M. Dr. Hoke. President's Address.
Dr. Hibbs. Operation for Fusion of the Hip in Tuberculosis of that Joint. A Preliminary Report.
Asked to Discuss: Dr. Clarence R. Starr
Dr. David Silver.
Dr. Galloway. The Open Operation for Congenital Dislocation of the Hip; Special Reference to Results.
Dr. Willard. End Results of Operations on Congenital Dislocations of the Hip.

Dr. Farrell. Comparing Results of Cases Treated by Operation with the Results of Those Treated by Closed Reductions. End Results.
Asked to Discuss: Dr. Z. B. Adams
Dr. Frank D. Dickson
Dr. Robert Soutter.
Dr. Roland Hammond. Transplantation of the Fibula to replace Bony Defect in the Shoulder Joint.
Dr. Lowman. An Underwater Gymnasium.
Dr. Key. Methods of Removal of Particulate Material from Joint Cavities.
Asked to Discuss: Dr. Leo Mayer
Dr. Sydney Cone.

Wednesday

9 A.M. Dr. Wilson. The Blood Supply of the Epiphysis of the Hip.
Dr. Legg. Late Results in Legg's Disease.
Asked to Discuss: Dr. Frederick C. Kidner
Dr. Robert B. Osgood.
Dr. Swaim. The Practical Side of the Treatment of Chronic Arthritis.
Dr. Burbank. Vaccine Therapy and Focal Infection in Chronic Arthritis.
Dr. Magnuson. Protein Arthritis.
Asked to Discuss: Dr. Philip Lewin
Dr. A. MacKenzie Forbes
Dr. W. W. Plummer
Dr. James Watkins
Dr. Melvin S. Henderson.

12 M. Second Executive Session.

2 P.M. Dr. Silver. The Rôle of the Capsule in Joint Contractures.
Asked to Discuss: Dr. George E. Bennett
Dr. Robert Schrock
Dr. James W. Sever.
Dr. Allison. The Nature of Synovial Fluid.
Dr. Thornton. The Treatment of Osteomyelitis of the Lower End of the Femur.
Asked to Discuss: Dr. William E. Gallie
Dr. Ellis W. Jones.
Dr. Steindler. Treatment of Scoliosis—Compensation vs. Correction.
Asked to Discuss: Dr. Edville Abbott
Dr. Samuel Kleinberg.
Dr. Henderson. Blood Chemistry in Ununited Fractures.
Dr. Orr. Fractures.
Asked to Discuss: Dr. Paul P. Swett
Dr. George W. Hawley
Dr. Edwin W. Ryerson
Dr. Charles F. Eikenbary.

BOOK REVIEWS

RADIOGRAPHY. A MANUAL OF X-RAY TECHNIQUE. INTERPRETATION AND THERAPY. Charles D. Endfield, M.D., F.A.C.P., Roentgenologist to St. Anthony's Hospital and Norton Memorial Infirmary, Louisville, Ky. Philadelphia, Pa.: P. Blakiston's Son & Co., 1925.

A manual of X-ray technique, interpretation and therapy for the student of medicine and the practitioner. The novice has neither the time nor the patience to read the numerous journals on the more exhaustive work. Consequently he should have available a brief work which he can consult. This work is not intended for the roentgenologist, but for the student.

The writer has endeavored to give the reader the sort of information and advice he requires in the simpler technical problems and the interpretation of the commoner lesions of the everyday sort of things, emphasizing the rule rather than the exception, also attempting to give in such detail as to be perfectly intelligible to the practitioner, one good technique for each of the ordinary routine examinations.

The first portion of the volume is devoted to equipment and dark room technique. This is followed by a roentgenographic study and technique of the various regions of the body. The last chapter is devoted to a brief consideration of X-ray therapy. The reviewer feels that X-ray therapy ought not to have been included in a manual of this kind as the elements of danger are too great.

The book contains much information in readily available form and is exceedingly valuable to the practitioner.

SCOLIOSIS. Samuel Kleinberg, M.D., F.A.C.S. New York: Paul B. Hoeber, Inc., 1926.

The make-up of this book from a mechanical point of view is very attractive. The glazed paper, the large type, the clear illustrations—all make the book easy to read. The publishers are to be commended by the author in helping him so to present his subject.

The subject matter of the book is one in which recent progress is so small, and of which so little is definitely known, that it will be impossible to criticise this book adequately in a review of this type. The Scoliosis Committee of the American Orthopaedic Association in the past has considered inadequate many of the methods of treatment described in the book.

We wonder whether Kleinberg does not refer to Jansen, a Dutch orthopaedic surgeon, when he attributes to German orthopaedic surgeons the belief "that scoliosis is often the result of a disturbed balance of the muscle action of the diaphragm, especially the crura of the diaphragm."

The material is presented in such an easy style that it might be useful to the general practitioner or to the student in the Medical School.

PRINCIPLES OF ORTHOPAEDIC SURGERY. P. Haglund. Gustav Fischer: Jena, 1923.

With this book the author has made a distinct contribution to medical science and especially to orthopaedic surgery. Not a text-book in the usual sense of the word, the book has been entitled "The Principles of Orthopaedic Surgery." Instead of enumerating the diseases that come within the sphere of the orthopaedic surgeon,

the author brings out the underlying principles as they may be applied in the practice of orthopaedic surgery in any country, irrespective of individual technique. The thought that the treatment of the disturbed function usually plays a more important rôle than the treatment of the disfiguring deformity is brought out from many angles. Away from the old idea that orthopaedic surgery is the doctrine of deformities, the author repeatedly and almost continually shows how the physiology and the pathology, as well as the treatment of the organs for holding the position and for carrying out the movements of the human body, comprise the modern conception of orthopaedic surgery. At the same time orthopaedic surgery is shown, not as the foster-child of surgery, but as an independent subject which, although it has borrowed from general surgery and internal medicine, has also taken root from the work of the old-fashioned brace-maker, boot-maker, gymnast, and masseur. Its close relationship to general surgery, internal medicine, and neurology is clearly seen, but orthopaedic surgery is not a high specialization of any of these subjects. No matter what field it may lead into, orthopaedic surgery is constantly concerned with the position and movements of the body, and the fundamental principles are always the same. Thus the knowledge of the general surgeon and internist can be complemented by obtaining the orthopaedic point of view. With this idea in mind the author intended his book primarily for non-specialists and students.

The book is divided into three parts. In the first part, under the title of "General Assumptions," there is a brief review of the history of the specialty, including a discussion of its present status. Then a chapter on the orthopaedic viewpoint in regard to the organs of station and motion is followed by a discussion of orthopaedic cases from a morphologic, and from a functional, and finally from an etiologic standpoint. The first part of the book is also concerned with the investigation, diagnosis, nomenclature, and records of orthopaedic cases. Each chapter is an interesting discourse in an essay style containing many useful facts. Underlying each and every chapter, however, is the idea of fundamental principles which unites them all to a single construction. All that is written holds the interest of the reader not only by its scientific value, but also by the ring of sincerity and the personality of the author which can be felt from cover to cover. What he writes seems to be his serious convictions, reached after twenty years of intensive interest in his subject.

In the second part of the book are taken up methods and means as applied to orthopaedic surgery. First, the surgical procedures; then the physical and mechanical therapeutics; and finally the external mechanical supports, such as splints, braces, and artificial limbs, are brought under discussion. Operative procedures are almost entirely omitted, the author's reason being that these can be found in detail in the usual orthopaedic and surgical texts. What is written about fixation and correction of joints is very instructive. The value of form-fitting supports is also convincingly portrayed.

In the third part of the book some important chapters from the field of more special orthopaedic surgery are taken up. This includes the congenital clubfoot, congenital luxations of the hip, functional insufficiency and deformities of the lower extremities and of the spine, chronic arthritis, bone and joint tuberculosis, infantile paralysis, the spastic conditions, and a short chapter on traumatic surgery. There is also a discussion of social problems in relation to orthopaedic surgery and of the institutional care of the crippled as carried out in Sweden, and finally a brief statistical survey of the authors' private clinic. In all the chapters the principles of orthopaedic surgery as previously outlined are applied, exemplified, and emphasized.

The volume is supplemented by a table of nomenclature which is not the least important part of this valuable book.

Throughout the entire seven hundred thirty-four pages the author keeps his purpose clearly in mind. Although written in simple but elegant language one can not refrain from a regret that this book is not open to the English reading medical world. The illustrations are rather extraordinary, numbering one thousand sixty-seven, and all of commendable excellence. For the student this book fills a gap which has been long left vacant. For the young orthopaedic surgeon it contains a fund of knowledge and inspiration toward the possibilities in a field that may have its future just appearing on the horizon.

INDIVIDUAL GYMNASTICS. A HANDBOOK OF CORRECTIVE AND REMEDIAL GYMNASTICS. Lillian Curtis Drew. Lea and Febiger, Philadelphia and New York, 1926.

The author has emphasized the importance of special individual attention needed by large groups which require physical education. To those intending to direct this form of work, this is a book which they will find complete and easy to understand.

One feels that Miss Drew has a wide experience and knowledge of her subject matter, and has the power to make the reader understand exactly what she means. In this she has shown a fine use of descriptive words and illustrations that leave no doubt in the reader's mind as to exact methods of procedure.

The author has subdivided the medical gymnastics into two parts:

1. Remedial, when applied to medical conditions.
2. Corrective, when applied to orthopaedic conditions.

Different exercises for specific types of cases are suggested, and the differentiation between class and individual gymnastic work is clearly defined.

THE CARE AND CURE OF CRIPPLED CHILDREN. THE SCHEME OF THE CENTRAL COMMITTEE FOR THE CARE OF CRIPPLES. G. R. Girdlestone. Bristol: John Wright and Son, Ltd., 1925.

The care and cure of crippled children constitutes a problem with many ramifications touching not only the domain of medicine, but also the fields of sociology, pedagogy, and economics. Much has been said and written on this subject of late years, but it is to be feared that a large part of it has been inspired by sentiment and enthusiasm rather than by common sense. After reading Mr. Girdlestone's little pamphlet the thought that emerges is that here are both an admirable statement of the problem and an effective plan for its solution. The author describes a scheme of organization which unites all medical and social agencies in an orthopaedic team for the purpose of discovering the cripple at an early period, immediately instituting treatment, and carrying it on continuously to the final cure, while at the same time making provision for education and at a later period vocational training when this is necessary. The plan was conceived to meet existing conditions in England, but it is universal in its application. The interests of the patient, the family, and the community are each considered.

The organization is planned with the County as the unit, and includes the central orthopaedic hospital where the operations are performed, the subsidiary local orthopaedic clinics in the smaller towns where the after-treatment is conducted by a specially trained nurse under the direction of the operating surgeon, who visits the clinic at regular intervals, and a hospital school to which are sent the cases requiring long-time treatment and heliotherapy.

The plan is one which will receive the support of all orthopaedic surgeons and which, if adopted everywhere, would bring incalculable benefit.

Current Literature

FRACTURES AND DISLOCATIONS

DEVELOPMENTAL ANOMALY OF PATELLA FREQUENTLY DIAGNOSED AS FRACTURE. J. D. Adams and R. D. Leonard. *Surg., Gyn., and Obstet.*, November, 1925, p. 601.

This condition was first described by Joachimsthal in 1902. Six cases are reported by the author, three of which had been erroneously diagnosed as fractures. The general contour of the patella is not distorted. One or two separate fragments of bone of the same structure as the patella are found in the outer and upper quadrant. The recognition of this condition is of extreme importance in compensation cases. The differentiation can easily be made by skiagraph. The deformities are usually bilateral.—*Edward S. Hatch, M.D., New Orleans, La.*

MANIPULATIVE (CHIROPRACTIC) DISLOCATIONS OF THE ATLAS. Edward S. Blaine, M.D. *Journal American Medical Association*, October 31, 1925, p. 1356.

A detailed description of the bony and ligamentous anatomy of the atlas and axis is given, as well as particular directions for the technique of taking skiagrams of this region.

Three cases are reported in detail, in all of which skiagrams revealed a dislocation forward of the atlas upon the axis following manipulations by a chiropractor, and having symptoms relative to the resultant compression of the spinal cord. One patient died, one was lost sight of, and in the third the symptoms decreased in severity.

The author concludes the paper with a just and scathing indictment of laws that will allow such practices as chiropractic "adjustments."—*H. A. Pingree, M.D., Portland, Maine.*

A CASE OF BILATERAL CENTRAL DISLOCATION OF THE HIP. Alfredo Jachia. *Chir. Org., Mov.*, October, 1925, p. 605.

Protruding of the femoral head into the pelvic cavity is a rare condition, whether it is due to a traumatism or to a pathologic process which destroys the base of the acetabulum. Professor Jachia's patient was a woman who had first a severe puerperal infection, then pelvi-peritonitis complicated with multiple abscesses over the sacral-iliac region. When she left her bed both hips were ankylosed. A roentgen-ray examination showed that both femoral heads were in the pelvis.

Although this kind of dislocation, when it is due to the presence of a neoplasm or echinococcus, is always a pathologic curiosity, it is also easily produced in those affections where the destruction of the bone tissue is not compensated by regeneration, as happens in the most of the cases of osteoarthritis. The writer states that the treatment of such cases is an arduous problem, because the lesion is bilateral. He has proposed to the patient that he perform a subtrochanteric osteotomy on one side, so that the limb could be adducted, and on the other to try a neoarthrosis.—*Felipe Muro, M.D., Farmington, Mich.*

THE PALLIATIVE TREATMENT OF INVETERATE CONGENITAL LUXATIONS OF THE HIP. Lance. VII Congress of the French Orthopaedic Society. La Presse Médicale, 1925, 1427.

The cases are those which cannot be reduced or which tend to recur. In recurring cases the author recommends the production of an ankylosis by reducing and leaving in the abducted position for three to five months and then gradually bringing the hip down. If the dislocation recurs, an osteoplastic operation is done to form a roof on the acetabulum. For irreducible cases he recommends: 1. Corsets and physiotherapy; 2. Transposition or inversion of Lorenz (the adductors are ruptured and then the hip is hyper-extended and abducted 30° and fixed in this position three months and later given exercises in hyper-extension and abduction); 3. Open reduction or resection of the head; 4. Extracapsular operations: 1. Open transposition, 2. building of a shelf over the dislocated head, 3. subtrochanteric osteotomy of Kirmisson followed by abduction and hyper-extension. If symptoms are present operation is indicated. In irreducible dislocations the extracapsular operations are less severe and give permanent relief.

Nové-Josserand reported good results after transposition in eighteen cases, removal of the head in three cases and osteotomy in six recent cases. Ducroquet recommended ankylosis in cases with a shallow acetabulum.—*J. Albert Key, M.D., St. Louis, Mo.*

TUBERCULOSIS

TREATMENT OF TUBERCULOSIS BY FINIKOFF'S METHOD. P. Delbet. *Bul. d. l'Académie de Méd.*, 1925, 94, 1083.

Delbet first permitted Finikoff to try his method on four hopeless cases. Three of the moribund patients died at the beginning of the treatment, but in the other there was marked improvement. He then gave him five cases so advanced that amputations or severe mutilating operations were indicated. In these the results were surprisingly good and all were healed within eight months. Still more encouraged, he permitted Finikoff to treat six less advanced cases. These were all healed or markedly improved in a few months. These cases were all observed by Delbet himself and he consequently endorses the treatment of Finikoff as given by Finikoff in his report.—*J. Albert Key, M.D., St. Louis, Mo.*

THE TREATMENT OF SURGICAL TUBERCULOSIS. A. Finikoff. *La Presse Médicale*, 1925, No. 99, 1634.

The objects of the treatment are to increase the natural defense of the body and to counteract the demineralization which is constantly present. Finikoff claims that the lipolytic powers of the blood are increased by injections of vegetable oil and the proteolytic powers are increased by iodine. In attacking the tubercle bacillus it is necessary to break through its fatty envelope before the organism can be reached by proteolytic ferments. The treatment consists of intramuscular injections of iodized vegetable oil, which are repeated every five to seven days over a period of six to eight months, and the administration of calcium salts. The vegetable oil is sterilized by boiling, and 1 c.c. of tincture of iodine is added to each 10 c.c. of oil just before the injection. For adults the initial dose is 10 c.c., and this is gradually increased to 20 c.c. The first few injec-

tions are followed by local reactions and slight increase in temperature. In successful cases improvement begins after four or five injections and cure results in six to eight months. The calcium is given as chloride or other salts in variable doses.—*J. Albert Key., M.D., St. Louis, Mo.*

End-Results in Treatment of Knee Joint Tuberculosis. Russell A. Hibbs and Herman L. von Lackum. *Journal American Medical Association*, October 24, 1925, p. 1289.

There is given a report somewhat in detail of 77 cases of knee joint tuberculosis treated at the Country Branch of the New York Orthopaedic Dispensary and Hospital, and observed over a time of from six to twenty-four years.

The authors' conclusions follow:

This study gives convincing evidence that the methods of diagnosis used in these cases, although they were those practiced universally at the time, are wholly untrustworthy.

We know of no method of making a diagnosis in knee joint tuberculosis except by aspiration, with guinea-pig inoculation, or by exploratory operation with tissue examination and guinea-pig inoculation.

Without a positive means of diagnosis, we are subjecting patients who do not have the disease to long periods of treatment, having our suspicions confirmed by the bone and muscle atrophy that appears as a result of the treatment. Subjecting the joints, especially of growing children, to long periods of immobilization in many instances does permanent damage.

Is it not more scientific, as well as more humane, first to make a positive diagnosis when this is possible, and in most instances it is, before we institute any method of treatment?

Whether any case of tuberculosis of the knee joint may be definitely cured with mobility is doubtful. Surely such would be possible only in a case in which the diagnosis was made very early.

We are forced to the conclusion, from this series at least, that the conservative methods here used have failed to accomplish a cure in all but three cases that were fused by nature. The other cured cases, sixteen, were fused by operation.

The elimination of motion by fusing the knee by operation offers the only means we know of curing the disease, and it should be done early in the disease, and may be done as early as the sixth year without any disturbance of the growth of the leg.—*H. A. Pingree, M.D., Portland, Maine.*

Fifty Cases of Tubercular Osteo-Arthritis Cured by Bone Grafting with Twenty-five Days in Bed. Carlos Robertson Lavalle. *Semana Médica*, November 12, 1925, p. 1209.

Robertson Lavalle is very optimistic about the results obtained with his original method of treating and curing tuberculosis of knee and hip joint by means of osteo-periosteal grafts. The technique used in the knee consists in boring tunnels which cross obliquely the epiphyseal cartilage and end in the thickness of the femoral and tibial epiphysis; in those canals are implanted pin bones which are connected by another

graft, buried in the subcutaneous tissue. In the hip are placed three pins, one through the femoral neck, the others above and below the acetabulum.

The writer states that since the tubercular joints always have venous extasis, this system of grafting permits drainage, while at the same time the arterial blood augments and the presence of the pin bones produces a condensing osteitis which helps to cure the pathologic process.

The general condition of the patient improves to such an extent that he eats and sleeps well, weight increases and the percentage of haemoglobin is high. The patient is allowed to use the operated limb within twenty-five days and the bone grafts are removed in from six to seven months.

In reading the ten clinical histories published, we see that after several years many of them have motion in the knees which would not be obtained with the usual methods of treatment. Many Argentine surgeons, although praising Lavalle's work, maintain that his method has a very restricted field, since, so far, in their hands, it has not given any encouraging results.—*Felipe Muro, M.D., Farmington, Mich.*

Tubercular Osteitis of the Ribs with Spontaneous Fracture. Lenormant. *La Presse Médicale.* August 5, 1925, p. 1042.

Spontaneous fracture in tubercular osteitis is rather rare. In 33 cases, operated upon by the author, it occurred in only the two cases reported below. A series of 110 cases reported by Koenig showed 8 cases of spontaneous fracture. This is because the lesion is usually just under the periosteum, the bone necrosis being a superficial erosion without compromising the strength of the bone. In these two cases of fracture, however, the lesion was central and extensive. In both cases the old age of the patient probably was an unfavorable factor.

Case 1. A patient, age 65, of general healthy appearance, came to the hospital with a cold abscess the size of a small egg over the ninth rib in the left axillary line. Palpation revealed abnormal motion and crepitation. A diagnosis of spontaneous fracture was made and confirmed by operation. The abscess was opened and found to have arisen from a small perforation in the outer cortex of the ninth rib. On resection of the diseased part of the rib an extensive central necrosis of the bone was found. The wound healed nicely but the patient died on the seventeenth day of pulmonary edema.

Case 2. Another patient, 65 years of age, had had pain in the left chest for six weeks. A cracking was felt on coughing and a swelling immediately appeared over the lower front chest. On entrance to the hospital there was a fluctuant tumor in the region the size of a large nut. Tenderness and crepitation were elicited on palpation. At operation the abscess was resected, with capsule without breaking it, together with the necrotic portion of the rib. On resection of the rib the parietal pleura was opened and a total pneumothorax resulted, but this absorbed and the wound healed, the patient being discharged in two weeks.—*William Arthur Clark, M.D., Pasadena, California.*

Treatment of Tuberculosis of the Knee in the Adult. 34th French Congress of Surgery. *Presse Médicale,* October 13 and 17, 1925, pp. 1367 and 1382.

The discussion was opened by Fredet and Vignard. Fredet advises resection in the adult because it gives a stable safe knee in a few months. It is best done by extra-capsular synovectomy followed by resection of bone. In sawing the bones an H-shaped

piece of metal is used to protect the popliteal space. In 783 resections from the literature there were ten deaths and thirty-three secondary amputations. If the patient cannot stand resection, amputation is indicated.

Vignard states that 25% of tuberculous knees begin between the ages of fifteen and twenty years. He advises heliotherapy. In patients who have not the time and money to go through with a prolonged course of heliotherapy he advises synovectomy with curetting and fitting of the epiphysis, thus preserving length and from 20 to 70 degrees of motion.

In the discussion which followed the opening papers, one is astonished at the number of men who advise conservative treatment in adults. Kummer, Dikansky, and Jentzer believe that conservative treatment should be the rule and resection resorted to only after it has failed. Delchef uses support and immobilization, but keeps his patients ambulant for the effect on the general health and to stimulate the epiphysis. He states that in tuberculosis, destruction of bone is not due to pressure, but is a biologic phenomenon. If the joint heals with deformity it is corrected by a supra-condylar osteotomy. Reynès resects only advanced cases and in most cases performs a careful synovectomy through lateral incisions. This is followed by early motion. Calot states that although he operated in his early days, he is now thoroughly convinced with Lannelongue, Kirmisson, and Broca that conservative methods give indisputably better results. He uses maximum general treatment, if possible, on the seashore. Locally he aspirates the joints and injects bactericidal substances into them. Trèves thinks that conservatism is the method of choice if the patient can afford it. He sometimes finds it impossible to differentiate hereditary syphilis from tuberculosis. Froelich thinks that amputation is more often indicated than resection. He notes: 1. congestive form, which heals without much treatment; 2. fungous form, which heals in three to four years; and 3. a rare dry osseous form, which demands resection. He treats conservatively with a walking splint. Sorel insists upon the air bath as part of heliotherapy. Rottenstein, in 34 cases, resected only two and amputated one. Bufnoir reports a perfect cure after four years of heliotherapy in a man 70 years old. Perdu practices in a region where heliotherapy is not practical, but cures most of his cases by phenol puncture. Mencière believes that resection is done too often in mild cases and not often enough in severe cases. In mild cases he uses phenol puncture and in severe cases he opens the joint, removes the synovial membrane and carbolizes the foci in the bone. He reports ninety cases, in patients aged 16 to 43 years, all treated successfully.

Opposed to the above is a not inconsiderable group of surgeons who hold views more in accord with those of American orthopaedic surgeons. Sorel emphasizes the importance of certain diagnosis. This having been made, choose the time for resection unless there are contraindications. He resected seventy-one of one hundred and eight cases in patients over 17 years of age. After resection the limb is fixed in a large plaster and coaptation of bone ends assured by roentgenograms. Machard showed the roentgenograms of ten cases which were cured by resection after they had resisted conservative treatment for two to six years. Delagenière resects adults, but in adolescents tries conservative treatment first. He reports eighty-two resections with eighty cures, one amputation, and one death. Tailhefer uses fenestrated ambulant plaster after resection. He reports twenty-four cases treated conservatively with ten cures, and nineteen resections, of which the eight which were reviewed were all cured. Péraire resects in all adults except desperate cases which he amputates. He reports twenty-five resections, all of which were successful. Bégouin advises resection by the method of Cham-

ponnier and Fredet. He reports twenty-nine cases with twenty-eight cures and one secondary amputation. In his patients union occurred in from seventy to ninety days and they returned to work in five months. Dupuy de Frenelle places tibial grafts on each side of the joint to aid osteogenesis in all but severe cases which demand resection. Constantini resects after the technique of Rochard. No tourniquet is used and the bones are fastened with a copper wire. Auvray considers resection the method of choice because it shortens the treatment, removes the lesion, and gives a more solid ankylosis than is obtained by conservative treatment. Judet thinks that there is no doubt but that resection is the method of choice. He advises against metal sutures in bone and fixes the leg in a large spica. Stefani resects as soon as growth is complete.

Lardennois resects in a curve with a Gigli saw. This permits the correction of deformity without destruction of the epiphysis. Lapeyre reports forty-two resections in adults with forty cured and two improved. Boeckel reports 135 resections in patients of 16 to 82 years, with four deaths and eight secondary amputations. He also performed five primary amputations during the same time (1880–1914). He insists upon a minute, methodical removal of the synovial tissues. Mauclaire reports seventy resections with sixty-five cures and five secondary amputations with one death. However, he treats many of his cases conservatively. Termier reports fifty-two resections with three secondary amputations and no deaths. He uses a large transverse incision (2/3 circumference of the knee) and removes both the capsule and the synovial membrane. He uses no tourniquet and no drains. Bérard and Santy were able to obtain data on sixteen old cases resected by Ollier. Five had died in the interim but only one of these from tuberculosis. Eleven were examined. The results on these, thirty-five years after operation, were ten with firm ankylosis with shortening of 5–9 cm. The atrophy of the quadriceps was compensated by a hypertrophy of the tensor fasciae lata. The legs showed varicosities, and roentgenograms showed a slight degree of coxa valga with elongation of the femoral neck.

The above opinions have been given in detail because they are representative of a group of surgeons who see a great deal of surgical tuberculosis. They serve to illustrate how far from uniform are all the present methods of treatment. One thing that strikes the reviewer as odd is that most of the resected cases get a bony ankylosis, a few are amputated, and a very few die. Nothing whatever is said about the possibility of a fibrous union after resection, which is the bugbear of the American surgeon.—*J. Albert Key, St. Louis, Mo.*

PARALYSIS

Calorimetric Studies of the Extremities Following Lumbar Sympathetic Ramisection and Ganglionectomy. George E. Brown and Alfred W. Adson. *Am. Jour. Med. Sc.*, August, 1925, p. 232.

The experimental and clinical work of Royle and Hunter on ramisectomy for spastic paralysis has awakened interest in the physiologic effects. These studies were undertaken to study the skin temperatures, heat production and radiation on the lower extremities before and after operation on five cases of spastic paraplegia in the Mayo clinic.

Operation was performed through a large abdominal incision, transperitoneally. The second, third, and fourth sympathetic ganglia with the sympathetic trunk were removed. The cases are reported in detail.

Summary: Five cases of spastic paraplegia are reported in which bilateral sympathetic ramisectomy and ganglionectomy was performed. The second, third, and fourth lumbar ganglia with the sympathetic trunk were removed and the rami divided. During the post-operative period marked increase in the skin temperature of the legs and feet was observed. Calorimetric studies with the foot calorimeter demonstrated marked increased heat production and heat radiation. There was complete absence of sweating in the legs in two cases. The vasomotor dilatation in the lower extremities, indicated by the calorimetric studies, was borne out by the clinical observations in respect to increased heat of the skin.—*Fred G. Hodgson, M.D., Atlanta, Ga.*

THREE CASES OF SYPHILITIC ANTERIOR POLIOMYELITIS. Fribourg-Blanc and Jausion. *La Presse Médicale*· September 5, 1925, p. 1190.

Chronic anterior poliomyelitis, or progressive muscular atrophy, was described by Duchenne in 1849 and by Aran in 1850. The possibility of syphilis as an etiologic factor was brought out by Raymond and others in 1893.

Case 1. Man, age 46; family history negative. In 1923 had a paralysis of the larynx of rapid development. Wassermann at that time four plus. About the same time there appeared a swelling between the right scapula and spine and a weakness in the right hand.

Examination showed in a rather underweight man with a right cervico-dorsal scoliosis, slight kyphosis and elevation of the right scapula. The right hand showed atrophy of the thenar muscles and other characteristics typical of the Aran-Duchenne syndrome. Sensibility normal, but strength and reflexes much diminished. Spinal puncture yielded a fluid negative in sero-reaction but containing albumin and sugar and 1.6 lymphocytes per mmc. Mercurial treatment has not yet caused any amelioration of the symptoms.

Case 2. A man of 40 developed weakness in the right hand fourteen years after a primary luetic infection, which latter had received treatment for about four years. The muscles of the thenar eminence showed diminished reflex. In February, 1925, he had an attack of acute contractures of right hand and arm muscles with loss of consciousness, loss of speech, and other epileptiform symptoms. Examination soon after this showed marked weakness in the right arm and hand and reflexes slight or absent. Muscular atrophy especially of thenar, hypothenar, and interossei. Ulcers were found under the tongue, which were luetic in character. The symptoms diminished and strength in the arm improved under anti-syphilitic treatment.

The third case was an acute poliomyelitis. A man of 23 had a primary lesion which was treated until the Wassermann was negative. Almost two years later he had severe pain in back and chest, coming on suddenly, accompanied by a temperature of 39. A few days later there appeared a brachial diplegia which persisted. A month later the left leg became paralyzed. Examination showed marked atrophy of scapular and upper arm muscles on the right. Hand weak, except finger flexion. Left forearm and hand also very weak and atrophied. Slight atrophy of left thigh muscles. Wassermann on the spinal fluid positive. After three months treatment the strength and appearance of the muscles was much improved, but the positive Wassermann persisted.

These three cases are instances of a rather rare condition. The diagnosis is based mainly on the history of a primary lesion and the amelioration of symptoms under antisyphilitic treatment.—*William Arthur Clark, M.D., Pasadena, California.*

Obstetric Paralysis. Report of Eleven Hundred Cases. James Warren Sever. *Jour. A. M. A.*, December 12, 1925, p. 1862.

The author presents a summary of the salient features of 1100 cases of obstetric paralysis said to be, and doubtless it is, the largest series of such cases ever recorded. The following table lifted directly from his report gives a good statistical resumé.

Obstetric Paralysis in Eleven Hundred Cases

Boys	551
Girls	549
Right arm affected	670
Left arm affected	430
Both arms affected, upper arm type	35
Both arms affected, whole arm type	22
Both arms affected, type not recorded	6
Upper arm type	829
Whole arm type	208
Difficult Labor	584
Ether used	502
Normal Labor	57
Head presentation, including face	443
Breech presentation, including foot and version	142
Presentations not known	458

Nothing especially new is recorded of the anatomic findings or methods of treatment, although in his words: "We have found that in certain cases the use of a splint seems to cause a certain amount of swelling about the wrist and elbow, and makes the exercise treatment, when the splint is removed, painful and difficult. . . . We have found also that the use of splint in certain children leads to a slower convalescence and a less free use of the arm, even with adequate treatment, so that we discard the splint, even in the face of the possibility of increasing muscle contractures, because we feel that we may be able adequately to supervise treatment to control the contractures, and in this way give the child freer and better use of the arm than it would have with the constant wearing of the splint." In later uncontrolled cases he advises his operation on the muscles. He is not unduly enthusiastic over plexus operations, but mentions their possibilities as a sort of didactic duty.

He concludes, "In the main, our experience has been that if we can get our babies early, we can in a great many instances prevent further operations, that is, on the upper arm types, and we can give them fairly good functional arms, with the exception of the ability to supinate normally. In the old cases in which there has been no treatment operation has to be performed almost invariably."—*C. A. Parker, M.D., Chicago.*

Convalescent Serums in Preparalytic Cases of Poliomyelitis. E. B. Shaw, H. E. Thelander, and E. C. Fleischner. *Jour. A. M. A.*, November 14, 1925, p. 1555.

On the principle that poliomyelitis is a general infection conveyed by the blood, the authors believe that its direct medication should be through the same medium, either by intravenous or intramuscular injections.

In the cases given in their report only the intramuscular route was used, as the precautions necessary to intravenous injections were such time-consuming factors as to preclude the latter mode of use in a condition where the therapeutic value was more of a prophylactic than of a curative nature and every hour saved was important.

They report five cases thus treated in the preparalytic stage with complete recovery without paralysis in every case. The time elapsed between the onset of the symptoms and the introduction of the convalescent serum varied from five hours, the shortest time, to twenty-two and one-half hours for the longest interval. The amount of serum injected varied from 40 to 70 c.c. In one instance convalescent blood was used, as no prepared serum was available. Detailed histories are given of their cases, ranging in ages as follows: 3½ years, 5 years, 5½ years, 7 years and 19 years.—*C. A. Parker, M.D., Chicago.*

BONE DISEASE

ATTENUATED BONE INFECTIONS: CONSIDERATIONS IN THE TREATMENT OF OSTEOMYELITIS. Walter M. Brickner. *Journ. A. M. A.*, December 5, 1925, p. 1782.

Brickner makes a plea for conservation in this class of attenuated bone infections, the "silent foci of localized osteomyelitis" of Phemister. He thinks the late-appearing foci are due to the activating of an old secondary focus laid down at the time of some previous acute osteomyelitis elsewhere in the body, although he is conversant with a simulating type apparently appearing *de novo* in several locations without a known preceding acute infection. In many of these localized abscesses a drill hole letting out the usually sterile or greatly attenuated pus is quite sufficient for healing. He deprecates extensive saucerizing operations for these conditions and is very conservative with operations even in the more extensive foci of acute osteomyelitis, being quite in accord with Starr, of Toronto, in his ideas and practices in this condition. He does not favor the usual extensive resections of good bone in sequestrectomy, but advocates removal of the necrosed portion with the minimum of injury to the involucra.—*C. A. Parker, M.D., Chicago.*

OSTEITIS FIBROSA AND HYPEROSTOTIC FORM OF BONE SYPHILIS. S. F. Wilhelm. *Surg., Gyn., and Obstet.*, November, 1925, p. 624.

This is a very valuable paper and should be read in its entirety. Eight cases are reported with conclusions as follows:

"There are gross anatomical and clinical resemblances between the hyperostotic form of syphilis of the long bones and osteitis fibrosa, both the senile hyperostotic-porotic form (Paget's disease), and the juvenile endosteal type (L. Pick). Coarser gross morphological similarities, such as deformities, elongation, and bowing, and especially the sabre blade form of tibia, are found in the affected bones of both diseases.

"Characteristic of hyperostotic syphilis are: (a) the marked, often tremendous, participation of the periosteum; (b) the more or less advanced narrowing and obliteration of the marrow cavity; (c) the sclerotic or finely porous quality of the newly built bone tissue.

"The sabre blade or sabre sheath form of tibia in syphilis may be due purely to a periosteal new formation of bone.

"Characteristic of the senile hyperostotic-porotic form of osteitis fibrosa (Paget's

disease) are: (a) the absence of periosteal participation; (b) the very great widening of the marrow cavity, even into the epiphyses; (c) the frequent lengthwise splitting up of the compacta into lamellae. The sabre blade tibia of Paget's disease is the result of the rebuilding and elongation of the bone."—*Edward S. Hatch, M. D., New Orleans, La.*

ARTHRITIS

INFLUENCE OF FOCAL INFECTION AND THE PATHOLOGY OF ARTHRITIS. Ralph Pemberton, F. A. Cajori and C. Y. Crouter. *Journ. A. M. A.*, December 5, 1925, p. 1793.

In this communication the authors endeavor to shed further light on the nature of the influence of focal infection and the pathology of arthritis. The subject is considered under four heads:

1. The sugar tolerance in arthritis.
2. The blood gases in arthritis.
3. Absorption from the gastro-intestinal tract in arthritis.
4. The influence of the circulation on the sugar tolerance in arthritis.

This necessitates a certain amount of repetition of previous studies. Under topic No. 1 they observed a lowered sugar tolerance in 60% of 400 cases previously studied in the army, and a low sugar tolerance in 53% of 77 cases in civil life. Particular attention was given to the point that an increased tolerance directly followed an ameliorating factor as the removal of a focus of infection. Under the second heading, in 132 arthritic patients, they determined that the average percentage oxygen saturation for the group was 56, while for a group of 15 normal persons it was but 43. Under heading 3 it was determined that there was no undue increase in the rate of intestinal absorption to account for the low sugar tolerance. Under heading number 4, experiments were made with three limbs supported above the body level, with the arthritic patient lying on the back in bed, to note the effect of the disturbed circulation on the lowered sugar tolerance. The results showed that in half the cases studied it was possible to induce a lowered sugar tolerance in subjects presenting otherwise a normal sugar tolerance. They say in conclusion, "In view of the close relationship of a lowered tolerance to arthritis and focal infection, this evidence approaches proof that a disturbance of the circulation, probably in the nature of closed capillary areas, constitutes an important part of the pathology of arthritis and the rheumatoid syndrome. If these findings are correlated with well-recognized benefits accruing in arthritis from measures which improve the circulation, the evidence becomes stronger."—*C. A. Parker, M.D., Chicago, Ill.*

DISCUSSION ON TREATMENT OF CHRONIC ARTHRITIS. Sir Thomas Horder. Preston King. *British Medical Journal*, October 19, 1925.

The paper of Sir Thomas Horder deals with arthritides not due to direct infection of joints, as by the gonococcus, tubercle bacillus, or the pyogenic bacteria, on the one hand, nor by trauma, on the other; but with the so-called "rheumatoid" arthritis. These are thought to be due to focal infections. In them the first indication is to treat the infectious focus. "Treatment by antigens should be supplementary to drainage of the infected area; not a substitute for it."

Chronic arthritis is considered a part of a general disease in which the patient requires treatment as much as, and sometimes more than, the joints. The nutrition requires careful attention. Nerve strain should be eliminated. Endocrine deficiencies and metabolic disturbances are often present and require correction. For the relief of pain, aspirin and pyramidon are found useful. Climate is thought not to be an especially important factor. "Spa" treatment is helpful, since it assists in building up the whole individual and is aimed at arthritis considered as a general disease. Among the local measures of value the author lists massage, ionization, diathermy, and active and passive movement.

Dr. King has had many years' experience with the treatment of chronic arthritis with the thermal waters of Bath. He feels that this treatment is of real benefit, and supplies a means of relief that is wanting in other methods of treatment. These waters are used internally and externally. They are diuretic, and markedly radio active, and seem to have factors whose nature is unknown, of especial benefit to arthritics. The element of suggestion, of faith in the Cure, which is fostered by the atmosphere and activities of a spa of recognized reputation, are potent for help. The treatment is most helpful in beginning cases, and obviously can do no more than relieve pain in the presence of structural changes. It is often more important to improve the arthritic's general condition than to concentrate on the affected joints. Used externally in deep baths, the hot water lessens tension and relieves pain in the joints. Immersion in the water is accompanied by its internal administration and followed by hot packs, encouraging diaphoresis. Other methods include douches with the water, followed by massage. Colonic irrigations with the hot water are of decided benefit where the colon is the seat of infection. Other modalities are the aerated and whirlpool baths, in which the water impinges upon the limb under pressure, producing a massage by the water. The warm swimming bath permits active movements under most favorable circumstances.

The Spas are thoroughly equipped for giving other modes of adjuvant treatment, such as ionization, radiant heat, and mechanical gymnastics. At a water cure establishment, taken in connection with the baths and in association with a whole community whose main animus is the gaining of health, these various modalities are used with much greater enthusiasm and devotion than when given at the patient's home, and the benefits accruing from them are correspondingly greater.—*Edward N. Reed, M.D., Ocean Park, Calif.*

Treatment of Rheumatoid Arthritis by Intramuscular Injections of Guaiacol, Iodin, and Camphor. S. Watson Smith. *British Medical Journal*, October 10, 1925.

The method was tried in nine cases, in both acute and chronic forms. Of these, five showed decided improvement following the treatment, but four were benefited only slightly.

This oil is not suggested to replace other established methods of treatment, but to supplement them. It contains 10% guaiacol, 10% iodin, and 5% camphor: the kind of base is not stated. The dose is .25 cc., increased to 1 cc. at the fourth injection: injections to be given intramuscularly and at intervals of three days.

The only reaction noted was some pain and stiffness around the affected joints twenty-four hours after the injection, with slight rise of temperature and malaise.—*Edward N. Reed, M.D., Ocean Park, California.*

MISCELLANEOUS

RECONSTRUCTION AND PLASTIC OPERATIONS ON THE HIP. Fred H. Albee. *Journal American Medical Association*, October 31, 1925, p. 1345.

Dr. Albee describes in detail two operations upon the hip-joint. One is for increasing the stability and muscular control in joints already mobile, but somewhat deranged in their mechanics. The other is for the purpose of making immobile joints more secure, and of changing those with a little motion to complete immobility.

In the first the great trochanter with a portion of the femoral shaft below it and a hinge at the lower end is abducted and allowed to unite in that position with all muscles attached. The broken head is removed, and the reshaped neck placed in the acetabulum. This gives the abductor muscles a better leverage by placing the trochanter at a greater distance from the mid-line of the thigh.

In the second, two grafts from the tibia are so placed, with the thigh in a favorable position, that their extremities penetrate the great trochanter on the one end and the ilium on the other. The joint need not be opened at all.

Both operations are conducted through the Smith-Petersen incision.

The paper is illustrated with several skiagrams and excellent line drawings. — *H. A. Pingree, M.D., Portland, Maine.*

LATER RESULTS OF PERIFEMORAL SYMPATHECTOMY IN THE TREATMENT OF THE VARICOSE ULCER. Giovanani Bonani. *Chir. Org. Mov.*, October, 1925, p. 569.

The report of Bonani about the results of the Leriche operation to treat varicose ulcer is important.

1. Post-operative reactions: Following the surgical treatment the vasomotor constriction diminished in the artery, the foot was noticeably less painful, and its temperature irregular.

2. Earliest effects: The first and fifth cases had a partial cicatrization in two months, the second, third, sixth, and seventh were cured in sixty, fifteen, twenty, and forty days, the fourth case failed to respond to the operation.

3. Late results: The first and fourth cases relapsed in five months, the sixth and eighth in three, and the third in fifteen days. Only the second case remained healed after eighteen months.

From this point of view the author states that the method is inadequate for the relief of this pathologic process.—*Felipe Muro, M.D., Farmington, Mich.*

CONTRIBUTION TO THE STUDY OF SPONDYLOLISTHESIS. Desfosses and Colleu. *Revue d'Orthopédie*, January, 1925, p. 15.

Luxation forward of the fifth lumbar over the sacrum causes characteristic symptoms which before the advent of the roentgen ray were variously diagnosed as lumbago, sciatica, neuralgia, and growing pains.

A typical case is reported as follows:

A girl of 20 had a prominence of the hips, first noticed at the age of 13. She continued having backache and tingling sensations in the legs for about seven years. Early roentgenograms were reported negative. When first seen by the authors she had a sharp forward curve just above the sacrum where the spinous processes could not be felt. Roentgenogram in lateral view showed the fifth lumbar body in a horizontal position in

front of the sacrum, the tip of its spinous process being in line with the posterior margin of the sacrum.

Three hypotheses are proposed to explain the cause of this condition:

(1) Fracture at the interarticular part of the spine.

(2) Lumbo-sacral arthritis with destruction of the normal relations of that articulation which allows the vertebra to slip forward.

(3) Imperfect union of the ossification centers of the vertebrae. In this case there was no history of injury or arthritis, so it was thought that she might have a fault in development, probably hereditary. It was not considered advisable to operate. An Albee operation would not prevent the body of the fifth from slipping down. She was kept in bed on her back. Nothing is said about the outcome of the case or about the possible value of a Hibbs operation. — *William Arthur Clark, M.D., Pasadena, California.*

General Atrophy as an Anomaly of Bone Metabolism. Julius Ferber. Archives of Surgery, November, 1925, p. 708.

Although clinical evidence seems to compel the inference that trophic centers direct the metabolism of muscles and bones, their existence has not been definitely proven. Bone atrophy is found in many pathologic conditions affecting bones. The author does not seem to agree with Brooks that bone atrophy is due to disuse alone. He discusses the various causes of bone atrophy and reports four cases with radiograms. Unfortunately the plates of the radiograms shown do not clearly demonstrate the points he endeavors to bring out. He says the bone changes were due, primarily, to a disturbance of bone metabolism. This delicate mechanism is under the regulatory control of the nervous system. — *Fred G. Hodgson, M.D., Atlanta, Ga.*

On Osteitis Deformans (Paget's Disease) and Its Relation to Osteitis Fibrosa and Osteomalacia. By R. Lawford Knaggs, *British Journal of Surgery*, October, 1925.

The history of the disease is briefly sketched and the clinical aspects presented by extensive quotations from the pioneer and classic descriptions written by Sir James Paget and by Dr. Wilkes. The striking clinical features are produced by thickening, elongation, and bending of the bones—usually the long bones. Anterior bowing of the tibia is the most noticeable of the bendings and is produced both by increase in length of the bone, while its ends are held at the same level by the attached but not elongated fibula, and by the influence of weight-bearing on the bone softened by disease.

The femur bows outward, the necks of the femora bend downward, the spine develops a marked dorsal kyphos, with increase of anterior lumbar and cervical curves. The arms elongated, chest flattened sidewise, and chin resting on the sternum, give a striking simian appearance when the disease is far advanced. Sometimes it is confined to a single bone: usually the tibia.

Pain is usually present before any bony change is evident and continues throughout the active progress of the disease, but is not severe and occasionally is entirely absent. The disease rarely begins before forty years of age. The bony changes comprise enlargement, both in length and thickness, with softening in the first and sclerosis in the final stage. In the stage of softening the bone becomes spongy and is permeated by a very vascular connective tissue marrow. The process consists of a

removal of the original osseous tissue and its replacement by cancellous bone, at first very porous, thicker and longer than the original, but of much rougher architecture, later becoming dense and hard. The process proceeds from the bone and not from the periosteum. While in the skull the bony enlargement is outward, causing no diminution in the size of the cranial cavity, in the spine the size of the canal is diminished, at times producing cord pressure symptoms. Histologically, osteitis deformans is very similar to osteitis fibrosa. In both diseases the changes consist of a disappearance of the original bone, and the substitution in its place of a vascular connective tissue from which new bone is subsequently formed. But in osteitis deformans there is a very regular and even distribution of new bone trabeculae throughout the diseased area. A noticeable feature is the presence of internal curvalinear markings within the trabeculae, produced by the replacement of the original bone by new bone. These are also present in osteitis fibrosa, but are not so pronounced. The complications of the disease include spontaneous fracture, occasionally recorded; necrosis of islands of bone, probably through cutting off of the blood supply by the extreme density of the process; and ulceration of the tissues overlying the tibial convexity. Atheromatous arteries are almost constantly present in the disease, and it is thought may be due to the same toxaemia which is supposed to cause the osteitis.

Pathogenesis: The earlier investigators thought the underlying cause to be a toxaemia, with trauma as the exciting cause. Attempts have been made to demonstrate a bacterial cause, but without success. The trend of the present opinion is toward a toxic cause, either metabolic in origin or absorption from the intestine, coupled with a constitutional susceptibility of the bones to the particular toxin.

Comparing osteitis deformans with osteitis fibrosa, the changes are essentially the same, but differ in degree. In the former, the original bone is not completely removed, the marrow is less deeply affected, the ossifying function is more vigorous, and the bone is not so rapidly or so severely weakened. This may be because, while osteitis fibrosa is a disease of young people, osteitis deformans affects middle-aged or old people, with more mature and resistant bone. Both diseases may be present in the same individual, and their causes are probably closely related. The author believes that osteomalacia is closely related to these two diseases, having a kindred cause, and differing in that the tissue which replaces the disappearing bone has too little vitality to reproduce bone. This he thinks is due to the depressed condition of the subjects of osteomalacia. The co-existence of osteomalacia and osteitis fibrosa has been demonstrated in one of the specimens. Syphilis seems to have little causative relation; nor is there much evidence of an endocrine cause.

The author believes the process to be inflammatory, but others have regarded it as metaplastic.

The article is very well illustrated.—*Edward N. Reed, M.D., Ocean Park, California.*

THE RELATION OF THE BONE MARROW TO THE LYMPHATIC SYSTEM; ITS RÔLE IN THE SPREADING OF CARCINOMATOUS METASTASES THROUGHOUT THE SKELETON. Anatole Kolodny. *Arch. of Surg.*, November, 1925, p. 690

Experiments were conducted on the femur, tibia, fibula, humerus, radius, and ulna of dogs. Three to five drops of India ink or carmin was injected into the medullary cavity and the opening sealed with Horsley's wax. The dogs were killed in from one to three weeks, and the lymph nodes in neighboring regions of the body were examined. The results led to the conclusions that the bone marrow has a definite lymph circulation,

and the regional lymph nodes drain the lymph circulating in the bone marrow. Another series of experiments was conducted in which a drop of emulsion of streptococci or staphylococci was introduced into the bone marrow. An early and marked reaction was noted in the regional lymph nodes of the experimental bones. An examination of the soft parts surrounding the femur of dogs that had been operated upon led to the discovery of a vessel impregnated with the same material introduced into the medullary cavity at the time of the operation. This channel, never described before, was found to be a permanent anatomic structure in the femur of dogs. This was concluded to be the lymphatic trunk draining the lymph of the bone marrow. A similar channel was easily found in the femur of an elephant and was as wide as the lead of a pencil. He states that these and other experiments explain the lymphogenous theory of the invasion of the bone by carcinomatous cells. Other ingenious experiments were conducted to show retrograde centrifugal lymph flow and to explain why the cancer skips the regional lymph nodes and yields distant metastases. This article gives in detail some excellent experimental work, it is full of interest, and seems to explain some very puzzling questions about the location of metastases. — *F. G. Hodgson, M.D., Atlanta, Ga.*

Club Hand, Congenital and Paralytic. H. L. Roche. 7th Congress of the French Orthopaedic Society. *La Presse Médicale*, 1925, p. 1428.

The radial and ulnar types of congenital club hand are described in detail. The treatment in young children consists of massage and stretching combined with some form of apparatus to hold the hand in the corrected position. Tenotomies may be necessary, but open operations are rarely performed. In older cases osteotomies or bone graft operations have been performed. Paralytic cases are classified as flaccid, spastic, and reflex contracture. Tendon transplant, arthrodesis of the thumb, and periarterial sympathectomy are mentioned in the treatment. Arthrodesis of the wrist is not mentioned. Kirmisson reported that in a case of spastic hemiplegia he had obtained a good result from Jones' operation (Conversion of the pronator teres into a supinator). — *J. Albert Key, M.D., St. Louis, Mo.*

Droop Shoulders in Adults. James C. Wilson. *Med. Jour. and Record*, October 7, 1925, p. 386.

Meriting greater attention than they have received from the profession in general, are cases with ill-defined pains in various portions of the upper extremity, the shoulder region and the occiput, sometimes with numbness and with cramps in the hands, for which no pathological basis can be determined.

Wilson reports here twelve such cases, ascribing the symptoms to mechanical compression of axillary nerves and to fatigue of muscles attending a forward droop of the shoulders. His clear, brief description of the anatomical peculiarities by which a heavy shoulder-girdle has its sole bony attachment to the skeletal frame through a loose-swinging clavicle, whereby its only escape from muscular tire is in a forward droop of the shoulder, affords a reasonable explanation of the origin, as well as of the variations of the accompanying symptoms, just as it offers also clear indications for the simple corrective shoulder-brace that he has found efficient in the relief of these symptoms. Naturally, correction is undertaken, also, of occupational and other postural habits that have led to the droop-shoulder.

While Wilson claims no originality for this explanation, he has done service in presenting this clear capitulation.—*Roades Fayerweather, M.D., Baltimore, Md.*

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